Appendix Q
Part 1

U.S. Fish and Wildlife Coordination Act Report

U.S. Army Corps of Engineers
Memphis District

ST. JOHNS BAYOU AND NEW MADRID FLOODWAY

PROJECT

Draft
Fish and Wildlife
Coordination Act Report

By

U.S. Fish and Wildlife Service
Ecological Services Field Office
Columbia, Missouri

July 2013

Table of Contents

Page

List of Figures

List of Tables

Appendices

Executive Summary

This is a summary of the findings and recommendations of the U.S. Fish and Wildlife Service (Service) and the Missouri Department of Conservation (MDC) contained in the Fish and Wildlife Coordination Act Report for the U.S. Army Corps of Engineers (Corps) St. Johns Bayou and New Madrid Floodway, Missouri, East Prairie Phase, Re-evaluation Study. The Corps has identified two alternatives that include: vegetative clearing along 4.3 miles of rural channels; channel enlargement along the St. Johns Bayou, the Setback Levee ditch, and St. James Ditch east of East Prairie; and a 1,000 cubic feet per second (cfs) pumping station near the existing gravity drainage outlet in St. Johns Bayou. The project also includes a 1,500 cfs pumping station at the mouth of the New Madrid Floodway in conjunction with a separately authorized levee closure.

The St. Johns Bayou basin and the New Madrid Floodway are drainages comprising part of the historic Mississippi River floodplain, and although highly altered, still perform floodplain functions critical to regional fish and wildlife resources. The New Madrid Floodway is unique in Missouri because it is the only significant portion of the historic Mississippi River floodplain still largely connected to the river. This ecologically valuable connection results in exchange of water, nutrients, and energy between the riverine and the wetland and terrestrial ecosystems inland. It is this regular exchange of water, nutrients, and energy (e.g., successional set back of plant communities) that makes this area so diverse and valuable to wildlife, while at the same time providing services to society in the form of flood-water storage and water filtration. Large portions of Mississippi and New Madrid counties, including the proposed project area, support fish and wildlife habitats and natural communities different from the rest of southeast Missouri (i.e., the Bootheel). High biodiversity is reflected by the large number of state-listed (Threatened and Endangered) plant, mussel, fish, amphibian, reptile, bird, mammal, and natural communities recorded in those counties, which is related in large part to the hydrologic influence of the Mississippi River on the lower St. Johns Bayou basin and New Madrid Floodway. The proposed project area still functions as an integral part of the Mississippi River ecosystem, and provides important habitats for neotropical migratory songbirds, and migratory waterfowl, waterbirds and shorebirds. The forested wetlands in the study area are only a small remnant of a once-extensive floodplain complex and are becoming increasingly scarce. That habitat has become so rare that it is now considered critical as refugia for a variety of scarce fish and wildlife species that formerly flourished throughout the lower Mississippi River. In spite of extensive modification, the river and its diverse connected wetlands within the proposed project area support nationally significant fish and wildlife resources that enhance biodiversity state-wide and regionally, and help preserve what is left of the ecological integrity of the lower Mississippi River.

The Tentatively Selected Plan (TSP) will eliminate spring overbank flooding that periodically inundates tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A wide variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals use those habitats during all or part of their life cycle. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by either project alternative. Approximately 27,731 acres of wetlands would no longer be seasonally inundated by backwater flooding under the TSP. Reduced flooding will result in a decrease of at least 900,000 and almost 4,200,000 Duck Use Days (in the St. Johns and New Madrid basins respectively) during spring

migration, a critical period for most ducks as they enter the reproduction phase of their life cycle. Project implementation will decrease fish spawning and rearing habitat values by approximately 50 percent in the St. Johns Bayou basin and at least 93 percent in the New Madrid Floodway. In addition, closing the levee to prevent natural spring flooding from the Mississippi River will virtually eliminate fish access to the Floodway during the critical spawning season.

We are greatly concerned about altering the extent and timing of seasonal flooding in the project area not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the regional ecosystem and cumulative impacts in the Lower Mississippi Valley. The Corps has proposed reforesting 9,423 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate a portion of lost wetland value to fish and wildlife, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, water quality changes, etc.. Fish and wildlife species with limited mobility (i.e., reptiles and amphibians) will experience a net loss of habitat within the project area that will not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Summary and Recommendations

The TSP will eliminate spring overbank flooding that currently may cover tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by the TSP. Seasonal backwater flooding in the New Madrid Floodway provides important floodplain habitat that supports an extremely abundant and diverse fish fauna (both floodplain and riverine), some of which are becoming regionally scarce. The interchange between the Floodway and the river supports a sustainable ecosystem not found elsewhere along the Mississippi River in Missouri. Alterations in the extent and timing of seasonal flooding in the project area greatly concern the Service not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

The Corps has proposed reforesting 9,423 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate a portion of lost wetland habitat value, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, and water quality changes. Fish and wildlife species with limited mobility (i.e., reptiles, amphibians, and larval fishes) will experience a net loss of habitat within the project area that may not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Because the project will negatively affect nationally significant fish and wildlife resources in the project area, the Service recommends that the Corps implement the following measures to ensure that fish and wildlife receive equal consideration with other project purposes:

1.) Construct the St. Johns Bayou Basin only alternative (2.1) that will avoid significant losses of fish and wildlife habitat and functions, while providing flood risk reduction focused on urban and residential areas, as well as public infrastructure.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:

    a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

    b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

    c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

    d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. Vortex weirs may also function as grade control structures.

    e.) Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

    f.) Avoiding dredging in a 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the TSP, they should incorporate the following measures as integral features of the selected plan:

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 291 and 290.4 feet NGVD in the St. Johns basin, and between 292.1or 287.6 feet NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures:

- Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). If protective covenants have not been placed on bottomland hardwood forests as described in 4(b), the Corps should reforest an additional acres to compensate for induced forested wetland losses because project-related reductions in flooding.

- Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

- Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below).

- To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest additional acres of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

- Provide shallow flooded (i.e., # 18 inches) land during spring and fall migration to compensate for project-related losses in shorebird migration habitat. Constructing moist soil areas to mitigate those losses would reduce the necessary acreage compare to cropland.

- Use both the Missouri Stream Mitigation Method and the Missouri Wetlands Assessment Method to assess project impacts and compensatory mitigation for wetlands and streams and conduct a review that includes the IRT.

- Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with most project construction activities, except for constructing the New Madrid Floodway Levee closure, and should be in place prior to project operation. Closure of the 1,500-foot levee gap should not be constructed until all mitigation measures are in place and functioning as planned.

- Provide a detailed adaptive management program to manage all compensatory mitigation features as well as modifications to proposed project operations to fully offset losses of fish and wildlife resources.

- Do not include existing conservation lands (e.g., Ten Mile Pond Conservation Area) lands as part of compensatory mitigation for this project.

Should the Corps pursue a Floodway closure alternative, we recommend alternative 4.1 which would have the fewest effects to fish and wildlife with minimal changes to project benefits, and a higher cost:benefit ratio than the preferred alternative.

Service Position

The proposed project TSP attempts to solve a local flooding problem for a select group of stakeholders within a river floodplain that influences populations of fish, wildlife, and people at much larger scales. The Corp treatise does not address larger scale conservation issues, including flood water storage and water filtration or the current and predicted dynamic nature of the Mississippi River and connecting wetland systems. Changes occurring in the rest of the Mississippi River watershed as well as our climate will likely add challenge to living in the floodplain. Expanding (not reducing) the area of natural communities providing buffering properties to society must increasingly be viewed as the preferred alternative (and less costly than engineered solutions) to flood control. Well placed fish and wildlife habitat conservation lands can serve to meet wildlife objectives while providing ecological goods and services, such as flood attenuation, to society.

Although replacement of the proposed fish and wildlife habitat losses in this unique system is nearly impossible, the Service and the Corps have strived to estimate measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate area of cover types (i.e., bottomland hardwood forests, moist soil, borrow pits) only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, fish and wildlife habitat quality and functions must also be maintained. While the proposed mitigation plan could potentially compensate some portion of fish and wildlife habitat losses that can be quantified with current models for estimating wildlife effects of water development projects, it would not, unfortunately, retain ecological functions of a connected floodplain-river ecosystem in the project area.

The Service has been intimately involved with the Corps throughout the last several years of project planning and we continue to have significant concerns regarding potential project effects to fish and wildlife resources, as detailed in the Department of the Interior's August 26, 2011, letter to Assistant Secretary Darcy. In spite of our repeated concerns, current project plans remain little changed from the original alternative which previously was the subject of two referrals to the Council on Environmental Quality, and federal litigation. The project would essentially eliminate a unique landscape and ecological feature in southeast Missouri and result in loss of thousands of acres of wetlands and their connection to the Mississippi River that cannot be adequately mitigated. This would occur as a result of a project with vaguely defined crop optimization benefits on some portions of both basins.

The Service opposes the New Madrid Floodway component of the preferred alternative because:

1.) As proposed, the New Madrid project features would cause substantial, irretrievable losses of nationally significant fish and wildlife resources, and greatly diminish rare and unique habitats found in southeast Missouri.

2.) We believe project-related wetlands losses are at odds with the federal conservation policy goals and sustainable water resources development.

3.) The St. Johns Basin only alternative (Alternative 2.1) is a technically and economically feasible alternative that would meet the project purpose while avoiding losses to nationally significant fish and wildlife resources.

If the Corps proceeds with project construction, at a minimum, they should include the Service's above-mentioned recommendations as integral components of the project.

Introduction

The St. Johns Bayou and New Madrid Floodway Project was authorized for construction by the Water Resources Development Act of 1986. The original project included 130 miles of channel widening and clearing, construction of a 1,000 cubic-feet-per-second pump station at the outlet of St. Johns Bayou, construction of a 1,500 cfs pump station at the outlet of East Bayou (Mud) Ditch on the Floodway, and several mitigation features. The project also included closure of a 1,500-foot gap in the Mississippi River Frontline Levee at the lower end of the New Madrid Floodway authorized by the 1954 Flood Control Act. A Feasibility Report and Environmental Impact Statement for the original project were filed in 1976 and a Supplemental EIS was completed in 1982. The U.S. Army Corps of Engineers (Corps) completed the Phase II General Design Memorandum in 1986, and it serves as the basis for the current re-analysis. The original project was never constructed because the local sponsor(s) could not meet cost-share requirements.

In 1996, Congress appropriated funds for the Corps to reformulate the original project. At the same time, the U.S. Department of Agriculture (USDA) designated the community of East Prairie, Missouri, which lies within the St. Johns Bayou basin, an Enterprise Community. In addition, the 1996 Water Resources Development Act exempted the East Prairie Phase from normal cost-sharing requirements, allowing USDA funds allotted to the community of East Prairie to be used to fulfill non-federal cost share requirements for a reformulated East Prairie Phase of the project. The purpose of the East Prairie Phase of the St. Johns Bayou and New Madrid Floodway Project is economic and infrastructure development in the project area (U.S. Army Corps of Engineers 1997). It includes 23.4 miles of channel work within the St. Johns Bayou basin, the St. Johns Bayou pump station, the New Madrid Floodway pump station, and the frontline levee gap closure. The project will provide a 25-year level of flood protection to the immediate area in and around East Prairie, and a 1.1-year level of flood protection to the New Madrid Floodway.

The Corps issued a Final EIS for the project in October 2000. The Service, through the Department of the Interior (DOI) and the Environmental Protection Agency (EPA) referred the project to the Council on Environmental Quality (CEQ) because of adverse effects to fish, wildlife and nationally significant aquatic resources. The Corps prepared a Supplemental EIS in 2002. The Service continued to oppose the Corps' preferred alternative and recommended an alternative that avoided closure of the Floodway. The Service informed the Corps the 1999 Biological Opinion was still applicable as the project effects to listed species were essentially unchanged. Missouri Department of Natural Resources initially denied the Section 401 certification for the project, but eventually resolved the remaining issues with the Corps through modifications of the 401 cert. In September 2004, Environmental Defense and other conservation groups filed suit in Federal Court against the Corps because of concerns regarding NEPA and Clean Water Act violations.

In June 2005, the Corps filed a motion with the court to remove the case from consideration and correct inconsistencies in the Final EIS regarding fisheries and wetland losses. The Corps issued a revised SEIS (RSEIS 2) and ROD later that year. While the court case was pending, the Corps began constructions of the levee closure and acquisition of mitigation lands. In June 2007, the

Court ruled the Corps was arbitrary and capricious in their effects analysis and ordered the EIS vacated and all work on the project deconstructed. Corps began project deconstruction in 2009.

From 2009 through 2011, the Corps conducted a series of Independent External Peer Reviews (IEPR) on the previous NEPA documents, as well as the models/tools used for project impacts assessment, and best available science (both natural resource and economic). Based on that input, the Corps provided the Service and EPA with a July 2011 internal revised draft EIS on the project. The Corps transmitted a revised Biological Assessment (BA) in an October 2011 letter to the Service. That BA concluded that the project is not likely to adversely affect the federally listed pallid sturgeon and interior least tern. At that time, the Corps also conducted an Independent Expert Panel Review (IEPR) of the DEIS so the Service deferred responding to the October letter pending the results of the review. In a May 1, 2012, draft Supplemental Fish and Wildlife Coordination Act (FWCA) report, the Service informed the Corps that the Corps preferred alternative appeared to be essentially the same project addressed by the 1999 Biological Opinion. The Service concurred with the Corps determination for the pallid sturgeon, however we noted that the project is likely to adversely affect the ILT. Should the Corps pursue their preferred alternative, they should contact the Service to discuss next steps in formal consultation.

The Corps provided the Service a June 21, 2012, request for initiation of formal consultation due to the agencies differing views on effects to the federally endangered pallid sturgeon and the ILT. The bald eagle was officially removed from federal listing in 2007. In a July 9, 2012, response to the Corps, the Service noted that the October 2011 BA did not include a complete project description, including effects to the species under consideration. We also noted the Corps had put the project on hold during development of a summer 2012 revised draft EIS. Thus the Service informed the Corps that we will continue to defer action on the BA pending a project document containing the information necessary to constitute a complete initiation package.

The Corps provided the Service a January 3, 2013, internal draft EIS on the project for our review and comment, with an expected January 18, 2013, public release. The Service provided the Corps a January 18, 2013, letter, with our preliminary comments on the draft expressing our continued concern regarding the effects of the project to fish and wildlife resources.

The latest version of the DEIS lists flood damage reduction as the primary project purpose, along with several ancillary socioeconomic objectives for the local communities. The vast majority of benefits accrue to agricultural lands.

This report supplements the analyses and recommendations provided by the Service in previous FWCA reports, planning aid letters, and comments on prior Environmental Impact Statements, which are incorporated by reference, including:

> USFWS May 2000. St. Johns Bayou and New Madrid Floodway Project, East Prairie Phase, FWCA report and June 2000 transmittal letter.
>
> USFWS June 2001. St. Johns Bayou and New Madrid Floodway Project, Scoping comments for revised draft Supplemental EIS.

USFWS July 2001. St. Johns Bayou and New Madrid Floodway Project, Planning Aid input on Floodway.

USFWS October 2001 FWCA letter report for revised Supplemental EIS.

USFWS June 2002. St. Johns Bayou and New Madrid Floodway Project, Supplemental FWCA report.

USFWS March 2006. St. Johns Bayou and New Madrid Floodway Project, Revised Supplemental, FWCA report.

DOl August 2011. Department of the Interior letter to Assistant Secretary of Civil Works recommending project reformulation.

The above-noted documents memorialize our longstanding coordination as part of our continuing FWCA input on this project, and can serve as a useful reference in project planning.

Description of Project Area

The St. Johns Bayou and New Madrid Floodway Project is located in southeast Missouri, adjacent to the Mississippi River and includes all or portions of New Madrid and Mississippi Counties (Figure 1). The project area extends from the vicinity of Commerce to New Madrid, Missouri. The area is divided into two drainage basins; the St. Johns Bayou basin and the New Madrid Floodway. The St. Johns Bayou basin covers approximately 324,173 acres and is drained by St. Johns Bayou through the Birds Point to New Madrid Setback Levee ditch via a gravity drainage structure near the City of New Madrid. The area is approximately 40 miles from north to south and reaches a maximum width of 25 miles. The basin has very low relief, ranging from 280 to 325 feet National Geodetic Vertical Datum (NGVD).

The New Madrid Floodway is approximately 33 miles long with a maximum width of 10 miles and covers 132,602 acres. The Floodway was authorized by the Flood Control Act of 1928 and constructed in the 1930s. In the event of a Mississippi River project flood, the Corps would breach the mainline levee along the Floodway to reduce flood stages in the vicinity of Cairo, Illinois and Paducah, Kentucky. The Floodway is bounded on the west by the Setback Levee, on the east by the Mississippi River Frontline Levee, and on the south by the Mississippi River. The upper third of this basin drains through a culvert in the Frontline Levee or via the Peafield Pumping Station during high river stages. The lower two-thirds of the basin drain through St. Johns Diversion Canal and Wilkerson Ditch into East Bayou Ditch (Mud Ditch) and then into the Mississippi River. Similar to St. Johns Bayou basin, the Floodway has little relief; elevations range between 280 and 315 feet NGVD. The New Madrid Floodway is unique in that it is the only significant portion of the historic Mississippi River floodplain in Missouri still largely connected to the river.

Originally part of the Mississippi River floodplain, both basins have been highly modified by intensive agriculture, the primary land use. The project area has undergone major alterations that have converted the landscape from 93 percent forested to over 80 percent agriculture (US Army Corps of Engineers 2013). The primary crops are soybeans, corn, cotton, wheat and milo.

The New Madrid Floodway was operated only two times so far: 1937 and 2011. After both events, some residents in the Floodway chose to relocate. During the 2011 Flood, the Floodway held approximately 90,000 acres of water for weeks that could have contributed to the flooding threats to up and downstream communities had the Floodway not been accessible. In spite of record flooding, most of the Floodway was planted in 2011 following Floodway operation (Olson and Morton 2012). In fact, some believe the impacts of floodwaters gouging soils at crevasse sites was in part due to the delay in operating the Floodway because of legal challenges (Olson and Morton 2012).

Fish and Wildlife Resources

Wetlands

Historically, the project area was covered by a mosaic of river meanders, oxbows, natural levees, forested wetlands, marsh, and open water. Federal flood control projects and Federal and local drainage projects, however, significantly altered the hydrology of the project area. Of an original 2.5 million acres of forested wetlands in southeast Missouri, approximately 50,000 acres remain (L.H. Fredrickson, cited in MDC 1989). Recently, the Service contracted a National Wetlands Inventory update of the much of the proposed project area (Table 1, Appendix A). Table 1 includes and Environmental Protection Agency assessment of area wetlands as well as updated figures used by the Corps of Engineers for project planning.

Within the project area, there are approximately 10,207 acres of forested wetlands. Most of those acres are bottomland hardwood forests found along the lower reaches of St. Johns Ditch in the St. Johns Bayou basin, and adjacent to the Ten Mile Pond Conservation Area and Big Oak Tree State Park in the Floodway. Bottomland hardwood forests are subject to regular seasonal flooding most years.

The Missouri Department of Conservation (MDC) has identified several significant examples of this rare community that occur in the project area (MDC 1999). The extent and duration of flooding determines the vegetation structure in any particular area resulting in an extremely diverse plant community. Tree species typically found in those forests are overcup oak, Nuttall oak, pin oak, willow oak, swamp chestnut oak, cherrybark oak, bald cypress, tupelo gum, sweetgum, sugarberry, green ash, pumpkin ash, American elm, black willow, black gum, cottonwood, water hickory, and red maple. Many of the forests in the project area also contain understory composed of swamp privet, buttonbush, possumhaw, sweet greenbriar, poison ivy, trumpet creeper, Virginia creeper, blackberry, and various herbaceous species.

The remaining forested wetlands in the proposed project area include riparian forest and deeper-water swamp, located in relatively low-lying areas. Riparian forests have vegetation similar to bottomland hardwood forests, and are found along the St. Johns Bayou, St. Johns Ditch, Mud Ditch, and most of the large drainage ditches. Deep-water swamps are found along old oxbows and permanently flooded lakes and ponds. They are typically flooded through much of the growing season, and in some cases all year. While swamps may contain tree species found in other forest types, the majority of vegetation consists of bald cypress, tupelo gum, red swamp maple, black willow, box elder, buttonbush, swamp privet, duckweeds, lizard's tail, and numerous other herbaceous species. MDC has identified several examples of this increasingly rare community occurring in the proposed project area including Big Oak Tree State Park, Ten Mile Pond and Weasel Woods (MDC 1999).

Scrub/shrub marsh and freshwater marsh are found in much smaller quantities in both basins, most of which is located on public land (e.g., Ten Mile Pond Conservation Area and Big Oak Tree State Park) and along perennial stream and lakes. Common shrub species in those habitats include young black willow, box elder, red maple, buttonbush, and swamp privet. Herbaceous species include rushes, cattail, giant cane, lizard's tail, smartweeds, and aquatic plants such as water lotus, coontail, duckweeds, Elodea, and water primrose. Although such plant communities have been highly altered, they can provide valuable wintering, migration, and breeding habitat for numerous species of fish and wildlife depending on the period and depth of inundation.

Open Waters

Permanent open water in the project area consists of natural streams, oxbows and ponds, ditches, and borrow pits. The sand and gravel alluvium underlying area lowlands act as a reservoir for storing precipitation. This water reserve is released slowly into the ditches creating well-sustained base flows (Pflieger 1997). Forested riparian corridors along reaches of major drainage ditches, streams, and borrow pits provide shade needed to sustain aquatic life by maintaining moderate summer water temperatures. These waterways vary greatly in size, water-current velocity, water clarity, depth, and amount of aquatic vegetation. Some ditches also contain deeper pools, woody debris, and a variety of emergent and submergent vegetation (Pflieger 1997). Lentic communities (i.e., borrow pits, oxbow lakes, and ponds) also contribute to diversity in the project area, which in turn supports an extremely diverse shellfish and finfish fauna.

Although more temporary, another aquatic component of the study-area critical to fish and wildlife are ephemeral ponds and overflow areas. Rainfall can produce these water features locally, particularly in the St. Johns Bayou basin. However, inundation from the Mississippi River produces up to tens of thousands of acres of this habitat annually. Such areas hold water for only days or weeks, yet are critical to migratory birds and breeding reptiles, amphibians, and fish.

Terrestrial Wildlife Resources

The Lower Mississippi River Valley extends nearly 500 miles from southern Illinois to the gulf coast and encompasses approximately 24 million acres. The New Madrid region includes southern Illinois and Indiana, the Missouri Bootheel, and western Kentucky. These are areas that have traditionally been important to migrating and wintering mallards. Wetlands in the New

Madrid region have been altered or lost at a rate even higher than wetlands in the main stem of the Lower Mississippi River Valley of Arkansas, Mississippi, Louisiana, and Tennessee.

In the project area, waterfowl are present throughout the year; wood duck, and to a lesser extent mallard, hooded merganser, and blue-winged teal, breed locally. However, it is non-breeding periods when the study are provides greatest value to waterfowl. The Lower Mississippi River Valley is the most important region for wintering mallards in North America. Mid-January census figures for the years 1970-89 ranged from 1.2 to 3.9 million mallards in the region. Five – 25 percent of the mallards observed during mid-winter surveys were recorded in the New Madrid Region. Surveys indicate that about 40,000 ducks (90 percent mallards) and 10,000 Canada geese use the periodically flooded areas of the St. Johns Bayou/New Madrid Floodway project area in late winter. Aerial surveys in December and January revealed an average of 31 percent (15,400) of Missouri's wintering Lower Mississippi River Valley mallard population occurring in this area. Large shallow-water areas (including farmed wetland) across the St. Johns Bayou basin and the New Madrid Floodway provide feeding and resting habitat for waterfowl during migration staging and wintering. Depending on continental population status, estimates of duck numbers migrating to southeast Missouri and northeast Arkansas range from 5-9 million (Figure 2, Bellrose 1980).

Migration is an important period of the waterfowl life cycle, where many species are pairing and building nutrient reserves, especially during late winter and spring. Hundreds of thousands of dabbling ducks (i.e., mallard, gadwall, green and blue-winged teal, northern pintail, American wigeon, shoveler, and American black duck), coots, and geese have been observed at the proposed project area following overflow of the Mississippi River and associated establishment of vast shallow-water conditions. In addition, diving ducks, such as lesser scaup, ring-necked duck, and canvasback use the deeper waters of the project area, with lesser scaup being a species of continental concern due to loss of quality migration habitat (Anteau et al. 2009). Wetlands available during these periods provide habitat to maintain birds in peak condition prior to winter and, even more importantly, provide essential dietary components to prepare mallards for reproduction in the spring.

Earliest fall migrations of waterfowl occur in mid-August when the first flocks of blue-wing teal arrive in the study area. Fall migration continues through late December and even early January as more winter-hardy species make their way south. Fall/winter migration has barely concluded before early migrants begin returning from the south, using the study area before most continue north to breeding areas in the mid-continent region. Wintering occurs at various latitudes and is dictated by habitat availability and freeze up, making the study area significant to waterfowl some years and less important other years. Warming winters in recent decades, has resulted northward patterns for wintering ducks in the Midwest (Soulliere et al. 2007) and the prediction is for still more birds to spend winters farther north as the climate continues to warm. Spring migration through the project area generally concludes by mid-March as the last of the shovelers and blue-wing teal depart. Because of their importance to waterfowl, wetlands in the proposed project area are a key component in the Lower Mississippi Valley Joint Venture conservation effort, a feature of the North American Waterfowl Management Plan (NAWMP 2004, 2012). Beyond waterfowl, the diverse aquatic communities in the project area also support hundreds of water-dependent and terrestrial bird species, both during breeding and migration. Although there are no rookeries (waterbird nest colonies) have been recorded in the study area for many years, wading birds such as the great blue heron, little blue heron, great egret, snowy egret, and yellow-crowned night heron depend on project area wetlands for foraging.

During migration thousands of shorebirds, such as greater yellowlegs, killdeer, dunlin, short-billed dowitcher, American golden-plover, semipalmated plover and solitary sandpiper, rely on shallow water, overflow areas to forage, replenishing critical energy supplies for the flight to northern breeding grounds. Some experts estimate between 60-80% of the world population of American golden-plover utilize the Lower and Mid-Mississippi River valley in spring, several hundred thousand birds in all (Bob Russell, USFWS, pers. comm.). As many as 1,800 birds have been recorded in nearby Mississippi County Missouri on April 1 (Robbins and Easterla 1992) and similar numbers would be expected to occur within the proposed project area during optimum water and foraging conditions. These birds prefer shallowly flooded agricultural lands, exposed flats in wetland complexes, and occasionally Mississippi River sandbars where they only occur in small numbers. When agricultural lands dry out, migrating shorebirds will move on to other foraging sites along the flyway. Flooded field conditions lasting until May 1 provide optimal potential as staging and short-term stopover habitat for these species. Although shorebird migration through the study area may occur from late March through early November in most years, significant peaks when the majority of the bird move are approximately April through mid-May in the spring and mid-August through mid-October in the fall. During the winter months, there are very few shorebirds present in the study area, except for scattered killdeer and Wilson's snipe. American woodcock also winter in the study area in very low numbers, in bottomland forests.

Forested wetlands support a significantly higher abundance and diversity of birds species compared to upland forests (Brinson et al. 1981). In the project area, numerous species of raptors, woodpeckers, warblers, thrushes and flycatchers use bottomland hardwood forests as migration and breeding habitat. Mississippi kite and Swainson's warbler, both species of conservation concern, breed in the study area, as do many other species dependent on bottomland hardwood forests, such as red-shouldered hawks, prothonotary warbler, wood thrush, and Kentucky warbler among others. During peak spring and fall migration (late April thru mid-May and late August through September, respectively) huge numbers of migrating landbirds travel along the Mississippi River floodplain, with remaining forest fragments acting as critical stop over sites for these birds on their long journeys. Documented abundances of Dickcissels (60.4 average/year) in the Deventer Breed Bird Survey (U.S.G.S.), which includes in the New Madrid Floodway, is one of the highest averages of any count for this species in the Mississippi River Valley or further east (B. Russell, USFWS, pers. comm.).

Research has pointed to sharp population declines in several neotropical migratory songbird species (e.g., white-eyed vireo, northern parula, cerulean warbler), particularly those that require large forested tracts to successfully reproduce (Robbins et al. 1989, Askins et al. 1990). In the Lower Mississippi Valley, the Partners in Flight bird conservation partnership is focusing on forested wetlands conservation because 13 of their 14 priority species require bottomland hardwood forests for breeding. The Service, state agencies and the private sector are developing management objectives to protect forest breeding birds and their habitats in the Mississippi Alluvial Valley. As part of that effort they have identified Abirds conservation areas@ (i.e., forest patches 10,000 acres or greater to support long-term, self-sustaining populations of forest breeding birds) that contain cleared areas to potentially be reforested.

Important game mammals that occur in the project area include white-tail deer, eastern gray and fox squirrels, State-listed rare swamp rabbit and eastern cottontail rabbit. The mink, beaver, raccoon, and muskrat are economically important furbearers found in the proposed project area. Other mammals found in or adjacent to the project area are striped skunk, coyote, red fox, various rodents, and big and little brown bats, tri-colored bat, Rafinesque's big-eared bat, northern long-eared bat and southeastern myotis.

Johnson (1997) notes that the native swamplands of southeast Missouri provide unmatched habitat for many species of amphibians and reptiles. Amphibians expected to occur on stream and lake edges, ponds, and in forested wetlands in the project area include the western lesser siren, marbled and small mouth salamanders, Fowler's toad, eastern narrow-mouthed toad, spring peeper, green treefrog, and bronze frog. Wetlands in the project area also support a number of State-listed rare species including the three-toed amphiuma, Illinois chorus frog, and the eastern spadefoot toad. Reptiles found in sloughs, swamps, ditches, oxbows, and ponds in the project area include Mississippi mud turtle, stinkpot, southern painted turtle, State-listed rare western chicken turtle, red-eared slider, alligator snapping turtle and the eastern spiny softshell, broadhead skink, black rat snake, State-listed rare dusky hognose snake, speckled king snake, water snakes, western ribbon snake, eastern garter snake, and rough green snake. This exceptional floral and faunal diversity at the study area can be traced to dynamic water levels, nutrients, and energy associated with connection to the Mississippi River.

Aquatic Wildlife Resources

The network of drainage ditches in southeast Missouri was largely constructed at the turn of the century when the much of region was converted to agricultural land. This development replaced the majority of the natural landscape leaving the ditches as the principal habitat for aquatic resources (Pflieger 1997). Changes in the aquatic fauna were undocumented, but this large-scale disturbance undoubtedly altered the original assemblage of species. Many species characteristic of lowlands have managed to persist in the area, but not necessarily in their former abundance. Other species that were able to exploit ditch environments may have benefitted from the altered conditions.

The proposed project area supports a remarkably rich and distinctive fishery. In all, 114 species representing 22 families have been collected from the project area-drainages and the Mississippi River. Of these species, 93 have been collected from ditches and bayous in the project-area drainage (Sheehan et al. 1998, MDC 1997). The remaining 21 species have been collected from the Mississippi River proper (U.S.G.S. 1991-1996, MDC 1997). Of the 93 species collected from the project area, 10 are considered endangered, rare, or on the watch list in the state of Missouri. One species, the golden topminnow, once believed to be extirpated from Missouri, was collected recently from the St. James Ditch (Sheehan et al. 1998). Many fish species collected in the St. Johns Bayou basin and the Floodway are either confined to the Mississippi lowlands or occur only occasionally elsewhere in the state (Pflieger 1997). The diversity and abundance of the fish fauna reflects the regionally-rare and diverse aquatic habitats in the project area (see above).

The New Madrid Floodway is the only portion of the historic Mississippi River floodplain in Missouri still connected to the river. Like all floodplains, annual flooding in the Floodway is an important part of its natural cycle, with exceptional plant, fish, and wildlife diversity and productivity related to regular nutrient and energy exchange with the Mississippi River. Backwater flooding in that area provides significant spawning, nursery, and foraging habitat for river fish (Sheehan et al. 1998). This event greatly enhances fish stocks and plays an important role in maintaining fish diversity in the Mississippi River and its floodplain. Most of the fish species that have been collected in the project area use the inundated floodplain for rearing and spawning or depend on free access to small tributaries such as Mud Ditch during their reproductive season in the spring (Sheehan et al. 1998). Baker et al. (1991) noted that floodplain ponds support some of the most unusual fish communities in river systems. Uncommon species characteristic of that habitat include chain pickerel, golden topminnow, flier, banded pygmy sunfish, and the cypress, mud, bluntnose and slough darters, all of which have been documented from the project area (MDC 1997, Sheehan et al. 1998, U.S.G.S. 1991-1996).

Sampling in the project area has documented significant fish production resulting from flood waters. Sampling of Mud Ditch and St. Johns Bayou below the outlet structure in 1993 and 1994 (mid-May to early July) collected large numbers of young-of-the-year (YOY) fishes. Those collections were made as backwaters drained to the Mississippi River (John Tibbs, Texas Wildlife and Parks, pers. comm.). The YOY specimens represented 27 and 17 species in 1993 and 1994, respectively. Similar results were reported by Sheehan et al. (1998) after collecting fishes from inundated floodplain and channel habitats during a time period which coincided with a rise and fall of flood waters in the project area. Adult and YOY fish collected represented 24 species from the New Madrid Floodway and 11 species from the St. Johns Basin. Adults of many species showed a reduction in gamete presence starting from the beginning of the flood pulse which suggested that spawning occurred during the flood event. The majority of species reported by Tibbs and Sheehan are river species that require quiet, off-channel habitat for spawning and rearing of young including sportfishes such as white bass and channel catfish and three species of commercially important buffalo (black, bigmouth, and smallmouth). These collections also contained extremely large numbers of YOY gizzard shad, which are a principal prey species for predaceous fishes (e.g. largemouth bass, white bass, catfishes, sauger, crappie, and gar). More recent sampling during the 2011 Flood also documented higher fish community diversity, densities, and growth rates in the Floodway than the adjacent river (Phelps et al. 2012). Eighty-six species were sampled in the Floodway contributing to a diversity index of 2.13, compared to 62 species from the river with a diversity index of 1.99. The authors speculate that higher growth rates can improve potential for recruitment to the population. The majority of fish captured in the Floodway were YOY and juveniles,-while the Mississippi River had a mix of adult, juvenile and YOY fishes. YOY sportfish abundance was much higher in Floodway than the adjacent river. Silver carp, an invasive species, was equally abundant in both the Floodway and the river. However, some speculate the Floodway, as a floodplain habitat, provides a competitive advantage to native fish species by supporting higher densities and growth rates (D. Herzog, MDC, pers. comm.). Although YOY shovelnose sturgeon and paddlefish were primarily collected in river samples, both species were also captured in the floodplain (Phelps et al.2012).

Sheehan et al. (1998) also reported differences in species composition between the St. Johns Bayou basin and New Madrid Floodway. Although more shad were collected in the St. Johns Bayou basin, the New Madrid Floodway yielded twice as many YOY fish species other than shad, including white bass and buffalo species. Sampling data also suggested either a single, protracted or more than one major white bass run occurring in the New Madrid Floodway. Those species differences are believed to be related to the hydrologic connectivity (i.e., fish access) between the Mississippi River and the Floodway during the spring spawning period.

Project-area waters also support diverse sport-fish communities in both the St. Johns and the New Madrid basins that provide significant angling opportunities for the public. The recreational fisheries provided by Mud Ditch, St. Johns Bayou, and the Mississippi River are important to this area of the state because of the lack of other fishable waters in the Bootheel. The lower New Madrid Floodway is the site of an important white bass fishery. In the spring, white bass from the Mississippi River enter Mud Ditch in large numbers to spawn. This annual event attracts anglers from New Madrid as well as surrounding areas of Sikeston and Dexter, Missouri (Randy McDonough, MDC, pers. comm.). During spring flooding, several species of buffalo and carp also enter the floodway from the Mississippi River to spawn. Anglers take these fish by gigging in shallow floodplain waters. In spring, Mud Ditch also provides significant angling opportunities for crappie, channel catfish, and flathead catfish as far as Ten Mile Pond Conservation Area (Dave Wissehr, MDC, pers. comm.). Those fisheries depend on that open connection between Mud Ditch and the Mississippi River to allow those species access into the Floodway to spawn.

In addition to seasonally abundant sportfishes, the project area supports a diversity of resident sport fishes. Abundant species include channel catfish, flathead catfish, largemouth bass, bluegill, white crappie, freshwater drum, and common carp. While fishing for any of the above species, anglers can also anticipate occasional action from a variety of less common sport fishes depending on the fishing technique used. These species include: spotted bass, blue catfish, yellow bass, sauger, rock bass, black crappie, longear sunfish, warmouth, black bullhead, yellow bullhead, chain pickerel, grass pickerel, bowfin, quillback, river carpsucker, northern hogsucker, river redhorse, shorthead redhorse, golden redhorse, spotted sucker, grass carp, and bighead carp.

The drainage ditches of southeast Missouri provide significant freshwater mussel habitat. The combination of moderate depth and current velocity, stable flows, sandy substrates, substantial groundwater flow, and abundant fish hosts found in these ditches provide good conditions for a variety of unionid species. Relative to natural rivers of similar size, mussel populations in these ditches are relatively diverse, abundant, and rather uniformly distributed (Barnhart 1998). Recent studies in the lowland region show that at least 30 species of unionids presently inhabit the lowland drainage ditches (Jenkinson and Ahlstedt 1987, Ahlstedt and Jenkinson 1991, Roberts et al. 1997). Such numbers are particularly significant in light of the dramatic decline in freshwater mussels in the southeastern United States which has one of the richest mussel fauna in the world (Williams et al. 1993). That decline is attributed to habitat destruction by dams, channel improvements and siltation (Neves 1993). In addition, competition from exotic species such as the Asian clam *(Corbicula fluminea)* and the zebra mussel (*Dreissena polymorpha*) is believed to be hastening the demise of native mussel fauna (Williams et al. 1993).

In a survey of project-area drainages, Barnhart (1998) collected 24 unionid species, representing over one-third of those known to occur in Missouri. The highest species diversity and greatest abundance of individuals was found in the lower portions of Lee Rowe Ditch and in the Setback Levee Ditch. Species composition differed between the Floodway and St. Johns Bayou basin. Thirteen species found in the St. Johns basin were not found in the Floodway. Only one species, *Obliquaria reflexa*, was found in the New Madrid ditches and not in the St. Johns ditches. Four species that occur in the project area, the rock pocketbook (*Arcidens confragosus*), flat floater (*Anodonta suborbiculata*), wartyback (*Quadrula nodulata*), and Texas liliput (*Toxolasma texasensis*) are considered rare in Missouri. Of these species, the rock pocketbook and flat floater are among the rarest unionids in the State (Oesch 1995). The ditches of the Bootheel lowlands have provided some of the most important habitat for these four species within the State (Barnhart 1998). Unfortunately, mussel diversity within project area ditches has decreased in recent years (U.S. Army Corps of Engineers 2013.) In Corps surveys of the same sites Barnhart (1998) sampled, mussels declined from 933 individuals representing 23 species, to 523 individuals representing 13 species (2005), to 160 individuals representing 15 species). The Corps speculated this decline reflects disturbance from periodic ditch maintenance. The Corps speculates the 1998 sampling period had time to recover from a period of channel maintenance in 1984 and 1988. Following the 2011 Flood, the USDA cleaned out 109 miles of ditches in the project area, likely setting back any potential recolonization. Nonetheless, the findings of Barnhart (1998) suggest ditch habitat is suitable for a diverse mussel fauna provided disturbance is minimized.

Crayfish are one of the dominant groups of invertebrates occurring in a variety of flowing and standing-water habitats (Pflieger 1997). They are an important food source for many fish (Momot et al. 1978) and are a major food item in the diet of bullfrogs in ponds, lakes and streams (Korschgen and Moyle 1963, Korschgen and Moyle 1955). A wide variety of other wildlife species, including snapping turtles, raccoon, mink, great blue heron, and belted kingfisher also prey heavily on crayfish (Pflieger 1997).

Although crayfish surveys specific to the project area have not been conducted, the Lowland Region in Missouri's Bootheel, supports a small but distinctive crayfish fauna. A State-wide crayfish survey conducted by the MDC found 10 species representing six genera in southeast Missouri (Pfleiger 1997). These species include, the shrimp crayfish (*Orconectes lancifer*), grey-speckled crayfish (*O. palmeri*), devil crayfish (*Cambarus diogenes*), White River crayfish, (*Procambarus acutus*), red swamp crayfish (*P. clarkii*), vernal crayfish (*P. viaeveridus*), Cajun dwarf crayfish (*Cambarellus puer*), Shufiddt's dwarf crayfish, (*C. shufeldtii*), digger crayfish (*Fallicambarus fodiens*), and shield crayfish (*Faxonella clypeata*). While most of these species have large distributions nationwide, the occurrence of several of those species in Missouri is limited to the bootheel. The State-listed species are the shrimp crayfish, the shield and digger crayfish, and the Cajun and Shufeldt's crayfish. Swamp and seasonally flooded roadside ditches and sloughs are important habitat these macroinvertebrates (Pfleiger 1997). The variety of ditch habitats is also important for crayfish.

Available data on the benthic larval insect fauna from the project area is limited to a small number of collections made in St. Johns ditch in 1995 and 1996. Those samples revealed a surprisingly diverse non-dipteran insect community (Samuel McCord, QST Environmental, pers. comm.).

Several "intolerant" taxa were found including *Perlesta* (Plecoptera), *Brachyucentrus* (Trichoptera, caddisflies) and *Ploycentropus* (Trichoperta). The presence of these species indicates good water quality and favorable conditions. Dominance of dipteran (flies) taxa usually indicates polluted waters.

Endangered Species

Two federally listed endangered species, the Interior least tern (*Sterna antillarum athalassos*), and pallid sturgeon (*Scaphirhynchus albus*), occur in the project area. That area is also within the historic range of the endangered fat pocketbook pearly mussel (*Potamilus capax*).

Interior least terns (ILT) nest in colonies on barren sandbars in the Mississippi River adjacent to the New Madrid Floodway. Based on annual surveys of the many tern colonies along the Mississippi River adjacent to the project area, terns numbers have ranged from 128 to 3295 (average = 672, USFWS 2013). Both adult birds and chicks require an abundant supply of small fish. In the Missouri River drainage, telemetered ILTs have been documented foraging for fish in shallow water habitats an average of 10 miles from their nesting sites (Stucker 2011). In the Lower Mississippi River, foraging terns have been observed feeding in a variety of habitats within 2 mi of colony sites (Jones 2012). Large numbers of adult terns have been observed foraging in the spring (mid to late May) in the lower end of St. Johns Bayou below the outlet structure and its confluence with Mud Ditch, because of the availability of large numbers of forage fish (Katie Dugger, University of Missouri, pers. comm.) as the backwater drained to the river. In addition, approximately 200 least terns have been observed in the 10-Mile Pond Conservation Area in the New Madrid Floodway (A. Forbes, USFWS, pers. comm. 2013).

Both adult and juvenile pallid sturgeon are reported from the Mississippi River and associated off-channel habitats in the project area. MDC documented a juvenile pallid sturgeon that was released in the Middle Mississippi River and later caught in a river backwater near Point Pleasant, Missouri (River Mile 878) in 1994. Nine of the sub-adult pallid sturgeon released by MDC into the Mississippi and Missouri rivers have been recaptured in tributaries or tributary confluence areas. Commercial fishermen report capturing adult pallid sturgeon in these same habitats. While these data suggest that connected tributaries and backwaters of the Mississippi River, such as Mud Ditch and the New Madrid Floodway, may be important feeding habitats or refugia for some life stages of pallid sturgeon, most adult pallid sturgeon from the lower river have been captured over sand in deep, main channel habitats with current (Reed and Ewing 1993, Constants et al. 1997).

The project area is within the range of the federally endangered fat pocketbook mussel, *Potamilus capax*. This species was historically widespread and ranged from the Mississippi River, Minnesota, southeast to the Wabash and Ohio rivers and west to the St. Francis River drainage of Arkansas. Currently, fat pocketbook mussels are limited to the St. Francis River drainage in Arkansas, the lower Wabash and Ohio Rivers in Illinois, Indiana, and Kentucky, and possibly in stretches of the upper Mississippi River adjacent to Missouri (U.S. Fish and Wildlife Service 1989, Cummings et al. 1990). The most significant remaining population of *P. capax* resides in ditch tributaries of the St. Francis River in northeast Arkansas and southeast Missouri (Jenkinson and Lasted 1993-1994, Roberts et al. 1997).

An environmental survey reported *P. capax* in the project area from Fish Lake Ditch at Hwy 80, just northeast of the Ten Mile Pond Conservation Area (CA) (Environmental Science and Engineering, Inc., (ESEI) 1978), however, no voucher specimens were provided. A 1980 survey of Fish Lake Ditch by Alan Buchanan, MDC, failed to find this species. He believed the mussel reported by ESEI to be *P. capax* was actually mistaken for *L. ventricular* (*cardium*), a similar species. The most comprehensive mussel survey of the St. Johns and New Madrid basins did not find any evidence of this species (Barnhart 1998). However, many of the ditches in the project area may be suitable habitat (Brian Obermeyer, Kansas Wildlife and Parks, pers. comm.).

The project area is also within the range of the federally endangered Indiana bat. Although the Indiana bat has not been recorded from the project area, it does occur in forested habitats across the Mississippi River in Kentucky.

Species of Conservation Concern

Two previously classified candidate fish species, the sicklefin chub and sturgeon chub, occur in the main channel of the Mississippi River in the project area. The chubs are small-bodied, native riverine cyprinids. Both those fish occur along and over sandbars in main channel border areas and chutes between the mainland and sandbar islands. Typically, they are found over sand and gravel substrate and in current velocities of 0-1.3 feet-per-second. The range of current velocities, however, reflects chub life history stage (Ridenour et al. 2009); larval and young chubs tend to be found in habitats that represent the slower end of the current velocity range not directly in main-channel flow while adults transition out the main channel flow habitat that represent the faster end of the current velocity range. Sicklefin chub and sturgeon chub are also an important component of the riverine food web because they are a significant component of pallid sturgeon diet (Gerrity et al. 2006). The reformulated project may affect availability of slow backwater habitat as nursery for these species.

Low numbers of wintering and nesting bald eagles (*Haliaeetus leucocephalus*) occur along the Mississippi River in New Madrid and Mississippi counties. In early 1998, three bald eagle nests were observed in the project area near Hubbard Lake. That year the active nest contained one chick (Chris Mills, pers. comm.) In 1999, that nest fledged 2 young. Since that time, that nest has been lost as the tree fell down. Bald eagles generally build nests in the tops of large bald cypress or cottonwood trees near water. Their diet consists of fish, although waterfowl and small mammals will also be taken. Ducks are particularly important food item for wintering bald eagles which often are associated with major waterfowl concentration areas. Just south of the Floodway, eagles successfully fledged young at Donaldson Point Conservation Area and have made several nest attempts elsewhere in Mississippi County.

Recently, many cave-hibernating bats have been affected by White Nose Syndrome, pathogen-caused illness that may lead to death. Estimates of bat losses are in the millions. As a result, the Service has been petitioned to list the northern long-eared bat, and is conducting a status review of the little brown bat. Both these species likely occur in or in the vicinity of the project area. Both species, as well as the Indiana bat, form maternity colonies in the summer, most often using mature trees with crevices or exfoliating bark. Little brown bats will also roost in buildings or man-made structures. The two species could possibly be added to the federal endangered or threatened species list over the next few years.

Public Lands

The MDC manages two conservation areas in the proposed project area. The Ten Mile Pond CA covers 3,793 acres of cropland, wetlands and forest. It is located in the Floodway along an old oxbow lake formed when the Mississippi River meandered over that section of floodplain. The ditches, ponds and lake on the CA provide significant opportunities for anglers. That area also provides opportunities for small and big game hunting, as well as waterfowl. Throughout the year, many species of migratory birds use the varied habitats found on the CA, including the federally endangered least tern.

The Donaldson Point CA lies largely outside the frontline levee along the Floodway. Most of that 5,785-acre area, is bottomland hardwood forest and woodland. Donaldson Point is home to several species not usually seen in Mississippi lowlands. These include the state endangered Swainson's warbler that nest in giant cane, Mississippi Kites, southeastern bat, Rafinesque's big-eared bat, swamp rabbit, and cotton mice. Bald eagles have established nesting territories in that area.

Big Oak Tree State Park is managed by the Missouri Department of Natural Resources. It includes approximately 1,000 acres of rare swamp and bottomland hardwood forest. Because it is one of the few remaining forested wetlands in southeast Missouri, it serves as a refugia for many increasingly rare plant and wildlife species and contributes significantly to the biodiversity of the region. The Park claims two national and three state champion trees. Several State-listed rare plant and animal species have also been recorded in the Park. Unfortunately, conditions in the park have to deteriorate because continuing drainage projects on surrounding lands slowly eliminates hydrologic conditions necessary to sustain these remnant native wetland communities.

Floodplain Ecology

The St. Johns Bayou basin and the New Madrid Floodway were originally part of the historic Mississippi River floodplain, and although highly altered, still perform floodplain functions critical to nationally significant fish and wildlife resources. As previously mentioned, the Floodway, in particular, is still largely connected to the Mississippi River which annually inundates much of the lower study area, providing an important exchange between terrestrial habitats and the aquatic system. Such flood pulses have been called the principal driving force(s) for the existence, productivity, and interactions of the major biota in river-floodplain systems (Junk et al. 1989). Not only do flood waters rejuvenate aquatic habitats (e.g., bayous, oxbows, sloughs, ditches, ponds and wetlands) on the floodplain, they also provide access to the floodplain productivity which is far greater than that of the river main stem (Junk et al. 1989, Guillory 1979).

Much of that productivity is organic detritus (e.g., leaves, grasses, etc.), however invertebrate levels are also significant. Eckblad et al. (1984) found the number of macroinvertebrates drifting from an upper Mississippi River backwater was three to eight times higher than in the main channel upstream of the backwater. Hrabik (1994) notes that floodplain production is high relative to the other macrohabitats based on estimated zooplankton densities and biological oxygen demand rates. In 1993, zooplankton density was 500 times greater in the wide versus the moderately-wide floodplain near Cape Girardeau (Hrabik 1994). That productivity in turn supports the fisheries and other aquatic resources of the river proper (Junk et al. 1989, Amoros 1991, Lambou 1990, Welcomme 1979). Based on post-flood studies on the Missouri River, Galat et al. (1998) noted that river flooding can facilitate zooplankton colonization of floodplain habitats as documented by higher cumulative species richness in scour holes that were continuously or periodically connected to the river than scour holes with no such connection.

The variability of natural flooding regimes and associated ecologic processes, both within and among years, creates and maintains diverse habitats and differential species success that supports the greatest biodiversity (Poff et al. 1997, Galat et al. 1998). Because of Mississippi River flooding, the study-area floodplain provides diverse habitats essential for spawning, rearing, foraging, and refuge to numerous aquatic species. Fishes that seasonally use the floodplain dominate the fisheries, biomass, and production in river-floodplain systems (Junk et al. 1989). Approximately half of the fish species of the lower Mississippi River use the floodplain as a nursery (Gallagher 1979). In most years, rising river levels inundate the floodplain in the spring, while rising temperatures and increased photoperiod trigger spawning in numerous fish species. In their work on a southern bottomland hardwood forest along the Tallahatchie River, Turner et al. (1994) collected more larval and juvenile fish from the floodplain than from the adjacent river, consistent with several other studies. Unlike the main stem of the river, the floodplain is characterized by slack waters, beds of aquatic vegetation, and organically rich substrates (Guillory 1979, Rissoto and Turner 1985), important habitat for fish spawning and rearing. Those areas often have aquatic vegetation, snags, and logs that also provide refuge from predators (Killgore and Hoover 1998). Other wildlife also benefit from spring floods.

Many species of amphibians throughout the project area require shallow waters to successfully reproduce. In addition to permanent ponds, sloughs, and ditches, spring flooding can cover up to 75,000 acres in the New Madrid Floodway alone. As those waters recede, they create thousands of ephemeral ponds critical to maintaining a healthy and diverse amphibian population. Habitats with variable flooding regimes have been shown to support highly diverse herptofauna. Work by Galat et al. (1998) documented differential use and abundance of reptiles and amphibians in a variety of wetland types. For example, connected scours were dominated by false map turtles and softshells; remnant wetlands had more sliders and painted and snapping turtles. Scour holes contained to the river contained the highest species richness. Remnant wetlands had the more species of salamanders and snakes than other types of wetlands. Those various wetland types also supported a diverse bird assemblage, where species use of a particular type of wetlands appeared to depend on wetland size, structural diversity, and depth. In addition, flooding increases invertebrate biomass, which becomes an important protein source for waterfowl and shorebirds on their migration to northern breeding grounds (Helmers 1992, Reinecke et al. 1989).

Mississippi and New Madrid counties, including the project area, support more diverse habitats and natural communities than elsewhere in the Bootheel. That increased diversity is reflected in the number of State-listed plant, mussel, fish, amphibian, reptile, bird, mammal, and natural communities reported for the two-county area (Table 2), and is due in part to the influence of the river's annual hydrologic regime on the lower St. Johns Bayou basin and New Madrid Floodway. Although greatly altered, the project area still functions as an integral part of the Mississippi River ecosystem, and provides important breeding, migration and overwintering habitat for numerous species. The forested wetlands in the project area, a small remnant of a once extensive forest complex, are becoming increasingly scarce. At the same time, they become more and more critical as refugia to numerous species that once flourished on the floodplain. In spite of numerous modifications, the varied habitats within the project area contribute significantly to the State's biodiversity and the ecological integrity of the lower Mississippi River.

Fish and Wildlife Concerns and Planning Objectives

In the last 100 years, there has been a dramatic decline in wetland habitats essential to maintaining waterfowl populations. Less than 2 percent of the historic regional wetland acreage remains today, and wetlands continue to be lost or degraded at an alarming rate. The St. Johns Bayou/New Madrid Floodway Project could affect up to 53,556 acres of wetland. In particular, forested wetlands will be impacted by the New Madrid Floodway portion of the project. The Service anticipated impacts to 90 percent of the existing bottomland hardwoods.

Historically, the Mississippi River Alluvial Valley was the largest bottomland forested wetland in North America covering approximately 25 million acres. Most of that area was subject to periodic flooding by the Mississippi River, providing invaluable habitat for fish and wildlife. Since the early 1700s, however, channelization and levee construction have reduced the natural floodplain of the lower Mississippi River by 90 percent (Fremling et al. 1989). Most of the forested wetlands have been converted to cropland. Private and publicly funded flood control and drainage projects have drastically changed the hydrologic relationship between the floodplain and the river, essentially eliminating seasonal interchange. Baker et al. (1991) called the reduction of seasonally inundated floodplain due to levee construction the single most deleterious alteration to the lower Mississippi River. Today, drainage ditches are the principal remaining year-round aquatic habitat for fish in much of the Bootheel (Pflieger 1997).

Past alterations to the Mississippi River floodplain have been accompanied by marked declines in both the abundance and diversity of fish and wildlife of the region. Many once-common species are becoming scarce and several are federally listed as endangered or threatened. Most of the remaining unique flora, fauna, and natural communities in the proposed project area are associated with wetlands remaining in portions of the St. Johns Bayou basin and the Floodway. Those wetlands, however, will lose most their wetland functions, and will be undoubtedly converted to agriculture once they are no longer subject to backwater flooding.

In recognition of the critical functions wetlands provide to fish, wildlife, and humans (e.g., improve water quality, store storm water, reduce flood stages, etc.), Congress enacted legislation (i.e., Clean Water Act) to protect remaining wetlands and to reverse historic wetland losses (e.g., 1985 and 1990 Farm Bills; Emergency Wetlands Protection Act of 1986; Water Resources Development Acts of 1986, 1992, and 1996; Agriculture Credit Act of 1987; Conservation Reserve Program; Food Security Act of 1992; Wetlands Reserve Program (WRP);

and Federal Agriculture Improvement and Reform Act of 1996). According to the Corps, as of 2010, there were 5,781 acres of Wetlands Reserve Program lands within both basin, most of which occur in the St. Johns basin below highway 80 (U.S. Army Corps of Engineers 2013).

The National Research Council (1992) noted that the cornerstone of modern floodplain restoration and integrated floodplain management rests on the understanding that Arivers and their floodplains are so intimately linked that they should be understood, managed, and restored as integral parts of a single system.@ To underscore the importance of floodplains as an integral part of the river ecosystem, Executive Order 11988 on floodplain management states that Federal agencies should avoid undertaking actions that directly or indirectly adversely affect natural floodplain functions and values. The above authorities' direct agencies to take advantage of every opportunity to protect, improve and restore wetland habitat in the study area and enhance regional fish and wildlife resources.

More recently, scientific recognition of our changing climate has led to greater considerations of effects of climate change on federal infrastructure investment and planning. In 2012, the Department of the Interior added policy guidance to it Manual to address climate change in project planning. Among the policies are:

1.) Promote Landscape-scale ecosystem-based management approaches to enhance resilience and sustainability of linked human and natural systems.
2.) Protect diversity of habitat communities and species
3.) Protect and restore core, unfragmented habitat areas and the key habitat linkages among them
4.) Maintain key ecosystem services

To address the previously noted problems and ensure that fish and wildlife resources receive equal consideration with other project purposes, the Service developed the following planning objectives to be incorporated into the St. Johns Bayou and New Madrid Floodway Project:

1. Avoid and/or minimize adverse impacts on fish and wildlife resources by minimizing negative impacts to marshes, forested wetlands and aquatic habitats in the project area, and ensuring fish access to the Floodway during spring for spawning and nursery habitat.;

2. Incorporate the goals of the North American Waterfowl Management Plan and other Administration wetland-related initiatives in project planning;

3. Provide compensatory mitigation to fully offset unavoidable project-related losses of wetlands and other aquatic habitat in the study area.

4. Implement a scientifically robust adaptive management (AM) program with clearly identified decision points, alternative actions, and costs. The AM program should ensure achievement of objective 3 above.

Evaluation Methodology

Estimation of project-related habitat changes is a fundamental technique used to assess project impacts to fish and wildlife resources. Those estimates also form the basis of other evaluations conducted by the Corps. In previous evaluations of project impacts, the Service closely coordinated with the Corps and MDC to document project-related effects to fish and wildlife resources. For this revised DEIS, however, neither the Service nor MDC was involved in the analyses. The following sections rely on the figures provided by Corps models, and notes on the limitations or inadequacies where applicable.

Wetlands were estimated several ways, as shown in Table 1, that illustrate significant differences between areas the EPA and the Service consider wetlands and those the Corps is using in its analyses as part of the EIS. The Service's estimates were done using standard NWI protocols that use remotely sensed photography, soil and on-site ground trothing. The method is based on functionality not regulatory status. The EPA wetlands assessment used a regulatory definition of wetlands (33 CFR 328.3(b)), although the assessment was not a jurisdictional determination. They used a probability-based survey design to estimate wetland acreage per protocols that EPA developed with the Corps. The methodology was adapted from a similar approach used on the Yazoo Pumps project, and included randomly selected points and surveys of NWI, National Landcover Dataset, Soil data and aerial photos to identify wetland signatures, including wetlands in agricultural production. Within the 5-Year Floodplain alone, the results in the EPA and NWI methodologies indicate a difference of roughly 10,000 acres in the St. Johns Bayou Basin and 30,000 acres in the New Madrid Floodway. Despite various methodologies, the EPA assessment and the NWI update are surprisingly consistent in their estimates of wetlands within the proposed project area.

The Corps based their wetlands analysis on jurisdictional status, maintaining that much of the acreage in the project area was delineated by NRCS as prior converted croplands, regardless of hydrology. This accounts for the biggest divergence between the three agencies' estimates. The Corps believes the functional species models (i.e., Waterfowl Assessment Methodology (WAM), shorebird model, and fisheries Habitat Evaluation Procedures (HEP)) capture the functional aspects of these wetlands to fish and wildlife and thus do not need to be considered as part of the wetlands analyses. However, not only does the Fish HEP fail to evaluate effects beyond the 5-year flood elevation, the Corps' model erroneously equates the fisheries value of flooded agricultural land to developed land (e.g., roads, parking lots, etc.) further discounting large portions of the project area. Similarly, the Corps' Hydrogeomorphic Methodology (HGM) functional modeling of wetlands effects does not evaluate wetlands above the 5-year flood elevation. The Corps asserts those areas would be unaffected by the project, which is directly contradicted by their analyses of economic agricultural benefits due to the proposed project drainage in areas above the 5-year flood elevation. The above 5-Year Floodplain results are even more at odds-roughly 20,000 acres and 50,000 acres for the St. Johns Bayou Basin and the New Madrid Floodway respectively. The Service does not consider the Corps' approach to be scientifically valid because it overlooks the value of tens of thousands of acres of connected floodplain habitats that provide significant and unique value to fish and wildlife resources.

In 1998, an interagency team that included the Corps, MDC, and the Service, used several tools to evaluate project-related changes in the quantity and quality of habitat for fish and wildlife. Most of those tools are based on the HEP (USFWS 1980). HEP is a method of estimating habitat suitability for evaluation species based on field measurements of parameters that limit the relative population density of a selected species. Using HEP (and similar tools), habitat quantity and quality can be measured for baseline conditions, and can be predicted for future without-project and future with-project conditions. The standardized, species-based method numerically compares future with-project and future-without project conditions to provide an estimate of project impacts on fish and wildlife resources. The Corps has continued to use the HEP methodology, however, the application of the HEP models and results for the current evaluation were not conducted collaboratively by the interagency team.

As we understand it, the Memphis District Corps of Engineers used a Geographic Information System to determine acreage of various land cover types within the study area based on satellite imagery. Those cover types and acreage were used to determine available habitat for the HEP analyses. The Corps then used stage area curves based on hydrologic modeling of the project area to determine the acreage that is inundated in the various evaluation models (i.e., HGM, terrestrial HEP, Fish HEP, Shorebird model, and WAM).

Fish and Wildlife Resources - Future Without the Project

Fish and wildlife resource conditions in the proposed project area are unlikely to change appreciably without project implementation. Existing wetland protection should minimize conversion of small wetlands to other uses. Some additional landowners may even take advantage of several wetland programs that offer financial incentives to restore functional wetlands on their property. Mature forested wetlands, such as in Big Oak Tree State Park, will continue to degrade (e.g., no regeneration) from previous hydrologic alterations unless water control programs are implemented to restore historic water levels. Forested wetlands along the lower reaches of St Johns Bayou may change to include species with greater water tolerance (e.g., cypress, buttonbush, etc.), responding to the high water levels when the St. Johns gravity drainage structure is closed.

Fish resources will continue to have access to the Floodway ensuring nursery and spawning habitat and refugia, as well as contributing to the productivity of the river system. Project area ditches will be disturbed periodically during channel maintenance. Those events, however, generally occur over small reaches, several years apart, allowing the much of the ditch biota to recolonize the affected area. Both waterfowl and shorebirds will continue to benefit from seasonal flooding in the project area during spring migration, with increasing numbers of waterfowl as our climate warms. Tens of thousands of acres of permanent, seasonal and ephemeral ponding will help meet the life requirements of those birds as well as numerous mammals, reptiles and amphibians.

Description of the Tentatively Selected Plan (TSP)

The Corps' TSP, also referred to as the Avoid and Minimize (A&M) or 3.1 alternative, includes vegetative clearing and channel enlargement along approximately 23 miles of rural channels in the St. Johns basin. The enlarged channel would be 120 feet-wide along 3.7 miles of the lower St.

Johns Bayou to the Setback Levee Ditch where it would narrow to 50 feet for 8.1 miles. The material removed would be deposited on a 120-foot wide embankment and allowed to revegetate naturally and placed under a conservation easement. The lower 3.5-miles of the St. James ditch would become 45-feet wide and the top bank along northern most reach (7.8 miles) would be widened to 80 feet, with the material placed in a 100-foot wide embankment. Bank work along the St. James Ditch would be restricted to one side of the channel to minimize impacts to riparian corridors; the upper reach of the St. James ditch would be avoided. The proposed project also includes a 1,000 cubic-foot-per second (cfs) pump station near the existing gravity drainage outlet to accommodate interior runoff. Impoundment of water in the St. Johns Basin would be managed between December 1 and January 31 to an elevation of 285'.

As part of the TSP in the New Madrid Floodway, the Corps proposes to construct a 1,500-cfs pump station in conjunction with a separately authorized project that includes four gated 10-foot by 10-foot box culverts across Mud Ditch and levee closure of the existing 1,500-foot gap at the southern end of the Floodway to a grade equivalent of 317.0'. Fourteen miles of the Setback Levee would be raised using 2.4 million cubic yards of material. Pump operations would include three periods:

	Gates (culverts) close
- Nov. 15 – Feb 28 – pump to elevation of 288.5'	288
- March 1 – April 15 – pump to elevation of 287'	286
- April 16 – May 31 – pump to elevation of 282'	284
- June 1 -14 Nov – pump to elevation of 278.5'	278.5

The Corps proposes to compensate project-related impacts to fish and wildlife resources in the St. Johns Basin by:

- Constructing nine transverse dikes in the lower 3.7 miles of St. Johns Bayou to create a low flow sinuous channel.
- Constructing a bank stability structure (*i.e.*, weir) at the confluence of St. Johns Bayou and Setback Levee Ditch to provide stability as well as structure.
- Constructing a bank stability structure at the confluence of Setback Levee Ditch and St. James Ditch.
- Creating stream bank slopes that are designed to prevent erosion and maximize fish and wildlife habitat.
- Restoring vegetated wetlands on 400 acres of agricultural land below an elevation of 285 feet.
- Restoring vegetated wetlands on 1,816 acres below the post project 5-year floodplain.
- Seasonally inundate 244 acres of farmland during the spring shorebird migration

The Corps proposes to compensate project-related impacts to fish and wildlife resources in the New Madrid Floodway and Mississippi River by:

- Providing a river connection to Big Oak Tree State Park via a gated culvert through the Mississippi River Frontline Levee.
- Restoring vegetated wetlands on a minimum of 1,800 acres of farmland surrounding Big Oak Tree State Park.

- Restoring vegetated wetlands on 387 acres of farmland below an elevation of 285'.
- Restore vegetated wetlands on 1,970 acres of farmland below the post project 5- year floodplain.
- Removing 3,050 acres of cropland from production in the batture to revegetate naturally to a bottomland hardwood or riverfront forest community.
- Seasonally inundating 1,286 acres of agricultural lands during spring shorebird migration period crediting 993 acres of conservation lands already owned and managed by the Missouri Department of Conservation (MDC) (i.e., Ten Mile Pond Conservation Area). The remainder would consist of 293 acres of agricultural lands in the basin.
- Restoring 432 acres of floodplain lakes (potential sites to be determined).

The TSP has been modified from the Authorized Project to include measures to reduce project effects on fish and wildlife species. The channel work along the St. James Ditch would be restricted to one bank to minimize impacts to forested riparian corridors and the work reaches would be designed with buffer strips consisting of both woody vegetation and warm season grasses with conservation easements. Combined with other Best Management Practices (BMPs) (e.g., adjusting ditch slopes) those measures would help minimize future sloughing and ditch maintenance. Pump operations would not lower spring water levels in the Floodway as much as the Authorized Project, allowing marginally greater fish access and potentially retaining more wetlands. The project would also employ BMPs in the design of borrow pits needed for the levee upgrade. The design of those areas would include features (i.e., low slopes, irregular edges, multiple depths, woody debris) to benefit fish and wildlife. Although the Corps has proposed mitigation for the project, it is unknown whether that mitigation will occur in the project area, elsewhere along the Mississippi River. In addition, engineered mitigation to replace functions of dynamic, natural environmental systems rarely work as planned. Furthermore, these mechanical solutions and associated infrastructure will require attention by fish and wildlife agency personnel potentially resulting in long-term/indefinite commitment of resources not consider in project costs and opportunity costs (i.e., the cost related to lost opportunities for completing other conservation work).

Project Impacts

Wetlands

As previously noted, the Service was not involved with impact assessment and future project conditions development. Therefore, the following comments are based on limited information provided in the DEIS. Under "Future with Project Scenarios," the Corps includes increasing acreage of WRP based on the assumption that future trends in WRP sign up in the project area will continue over at least the first 25 years of implementation. The Service finds this assumption highly uncertain given record commodity prices and declining funding for farm conservation programs. The Corps does not provide figures for future conditions without increasing WRP acreage, so we used Tables 3.1 and 3.2 showing existing conditions, to conservatively estimate forested wetlands future with project (i.e., without additional WRP signup) conditions.

Implementation of the preferred alternative would greatly alter the hydrologic regime of tens of thousands of acres of wetlands. According to the Corps stage area curves, projected 2-year flood elevations (approximate wetland level), and land cover, under the TSP, approximately 27,731 acres would no longer be seasonally flooded. In the St. Johns Bayou basin, the preferred alternative would decrease the acreage of existing forested wetlands receiving riverine backwater flooding by approximately 13 percent. In the New Madrid Floodway, implementing the TSP would reduce forested wetlands flooded by backwater by 58 percent. The Floodway would also have a 13 percent decrease in herbaceous wetland acreage affected by riverine flooding. Such changes in the hydrology of those wetlands would greatly diminish their contribution to the riverine ecosystem. Those remaining wetlands not dependent on backwater flooding would become isolated, depressional systems. Wharton et al. (1982) noted that the productivity and ecologic value of forested wetlands depend on the "...primary driving force, the fluctuating water levels of the riverine system." As previously mentioned, the New Madrid Floodway currently is the only tributary floodplain still connected to the Mississippi River in Missouri. Implementation of either project alternative would sever that connection, essentially decoupling the floodplain from the river.

Project-related hydrologic changes would also lead to widespread dewatering of the remaining wetlands. Currently, 9720 acres of forested wetlands occur in the project area. Some of the largest unprotected, contiguous stands of bottomland hardwood forests remaining in southeast Missouri occur in the lower St. Johns Bayou basin and will be most affected by project implementation. Under existing conditions, forested wetlands account for approximately 8.0 and 7.5 percent of the wetlands in the area below 300 feet NGVD (the area to be affected by either alternative) in the St Johns and New Madrid basins respectively. That figure includes public land, timber company land, and WRP land.

Big Oak Tree State Park

Although the remaining wetland areas are characterized by very heavy soils and a high water table, the same is true for much of the cropland in the project area. Overlaying the Corps' landcover data on the wetland map shows that most of the remaining undeveloped wetlands, particularly forested wetlands, correspond most closely to property lines and drainage networks, not the underlying soils. In many cases, modifications to the project area's natural hydrology and land owner practices have a greater effect on the distribution of wetlands than does the presence of hydric soils.

Although the Mississippi River seasonally recharges the groundwater in the eastern portions of the proposed project area, the interaction between surface water, groundwater and river seepage is poorly understood (U.S.G.S., per. comm.). Currently, the Corps is working on several seepage control features in the Floodway as part of the Mississippi River Mainline Levee enlargement that will further modify water patterns in the project area. In addition, the cropping patterns in areas previously subject to backwater flooding are likely to emphasize more profitable crops and increase the use of irrigation, increasing surface and groundwater demands. Both project alternatives would lower portions of the Setback Levee Ditch and the St. James Ditches by 5 feet. In a study of the effects of channelization on forested wetlands, Maki et al. (1980) noted that outside of seasonal effects, the greatest differences in ground water levels were caused by channel modification. They noted that deepened channels intercepted the groundwater table and depleted soil moisture in adjacent bottomlands. The water table in channelized basins remained at least 1.3 feet below the level found in natural watersheds regardless of land use. Luckey (1985) also found a similar pattern in southeast Missouri; namely that enhanced drainage lowers the groundwater levels in the soil. Maki et al. (1980) further noted that channelization not only reduces the amount of ponding on floodplains, but shortens ponding duration. During spring, summer, and fall, evapotranspiration demands can effectively eliminate surface ponding.

In light of the above factors, it is difficult to predict with certainty post-project surface water patterns in either basin. Under either project alternative, however, spring water levels will be significantly lower than existing conditions. The Corps believes that there will be no indirect project-related changes in jurisdictional wetlands because they anticipate that rainfall and groundwater seepage will maintain saturated soils in the existing wetlands sufficient to meet the wetland criteria. However, widespread changes in the hydrology of existing farmed wetlands, from pre-project inundation to post-project saturation, would have significant implications under the Food Security Act (FSA). The FSA stipulates that farmed wetlands must have a 50 percent chance of being seasonally ponded or flooded at least 15 days during or 10 percent of the growing season, whichever is less. Although the USDA, Natural Resources Conservation Service (NRCS), has previously called many of the farmed wetlands in the project area prior converted croplands, discussions with NRCS (Pat Graham, pers. comm.) indicate that the mapping protocols used for those uncertified determinations were very limited, and that using current wetland protocols would show far more wetlands in the same area. The NRCS analysis included in the DEIS, Appendix E, does not have enough detail to demonstrate the methods employed can distinguish the inundation criteria (15 days) of farmed wetlands. The is particularly confusing given the dramatically larger acreages of farmed wetlands indicated by the EPA and NWI assessment, as well as the Corps hydrologic modeling of the project area. Based on the Corps modeling results, project-related hydrologic changes may remove inundation on up to 20,000 acres of cropped wetlands in the Floodway alone. Without surface-water flooding or ponding during the growing season, those acres would not provide wetland functions to support fish and wildlife.

Furthermore, project implementation will replace a naturally-variable flooding regime with a well-regulated, fairly predictable flooding pattern. The level of risk to farmers who chose to crop previously marginal areas is greatly lowered. Considering the changes in future surface-water levels throughout the project area, reasonably foreseeable modifications to the project area's drainage patterns, existing land practices, and the USDA projections of future wetland conversion to agriculture, the Service believes most of the privately-owned forested wetlands no longer subject to backwater and overland flooding will face greater development pressure and likely will be converted to agriculture use.

Project implementation would not only reduce riverine flooding in both basins, but it would also significantly alter the temporal and spatial variability of that flooding. As proposed, pumping operations in the St. Johns Bayou basin and the New Madrid Floodway would replace a natural, highly variable flooding regime with a flooding pattern that would be the same each year; higher water levels (i.e., + 11 to 17 feet) in the winter, and lower water levels (i.e., - 4 to 8 feet) throughout much of the spring. This will eliminate years of high water that infrequently but regularly rejuvenate higher elevation marshes, forested wetlands, and riparian areas. Based on the Corps' hydrologic analyses, the preferred alternative would eliminate such flooding on 393 acres of forested tracts in the St. Johns Bayou basin, and 3475 acres in the New Madrid Floodway. In addition, the proposed pumping operations will maintain artificially high winter water levels in the lower portions of both basins, further stressing the forested wetlands in those areas.

In their treatise on green-tree reservoir management, Fredrickson and Batema (1992) underscore the importance of fluctuating water regimes to the maintenance of high productivity in forested wetlands. They noted several characteristic flooding patterns in unaltered forested wetlands that should be emulated in managed systems. Those include ensuring flooding after trees break dormancy in the spring; minimizing flooding that overtops red oak species during the dormant season that could lead to high mortality and prevent regeneration; and ensuring hydrologic variability within and among years (Fredrickson and Batema 1992). The TSP pumping operational plan does not incorporate those measures. Consequently, we believe those few forested wetlands remaining after project implementation will progressively degrade.

Floodplain wetlands provide an extremely important function at a landscape-level. Their capacity to store flood waters can greatly reduce river stages and destructive flood potential downstream (Taylor et al. 1990). In fact, cumulative losses of floodplain storage capacity in the Mississippi River Valley have led to increased flood stages in the lower river (U.S. Army Corps of Engineers 1998). Those higher stages, in turn, lead to additional flood control projects (e.g., levee enlargements) to protect lives, property, and existing infrastructure. The Corps, recognizing the importance of that storage capacity, has designated certain floodplains along the lower river valley as "floodways." Those floodways are integral components of the Mississippi River and Tributaries Project. For example, the New Madrid Floodway was constructed to lower stages in Cairo, IL and Paducah, KY during a" project flood." The proposed levee closure at the mouth of the Floodway would significantly decrease the available floodplain storage capacity along the lower river during river stages lower than a “project flood” (when the Corps would operate the Floodway), possibly affecting flood stages along this reach of the Mississippi River. As previously noted, the Floodway accommodated 90,000 acres of water prior to operation during the 2011 Flood, water that would have been forced against levees elsewhere on the river. Ecological functions, such as flood attenuation to help prevent property damage currently provided by the Floodway are not included in the cost:benefit calculations, but are extremely important to river communities.

Terrestrial Wildlife Resources

Although difficult to assess in a dynamic environment, estimates of project-related impacts that have been quantified to date include winter carrying capacity for waterfowl, habitat value for forest wildlife and foraging habitat for migratory shorebirds. Effects on other wildlife (e.g., reptiles and amphibians, wading birds), although not quantified, will be discussed qualitatively.

Implementation of the proposed project alternatives would greatly alter the habitat available for wintering and migrating waterfowl. One negative impact will be the loss of diversity resulting from a dynamic river connection and associated flooding. Implementation of the proposed project will control flood timing, duration, and depth through pump operations, removing natural variability which contributes to the overall health and sustainability of wetland ecosystems. The Waterfowl Assessment Methodology (WAM) was used to quantify changes in the potential carrying capacity (i.e., food) for wintering and spring migrating waterfowl in the project area. We understand the WAM assumed increases in WRP lands in all future scenarios, thus the results likely overestimate the availability of suitable duck habitat. WAM results indicate that the TSP would potentially produce an increase of 978,809 duck-use days (DUDs) in December and January, while reducing DUDs by 995,104 in February and March. In the New Madrid Floodway, WAM result indicate the TPS would potentially increase DUDs by 1,376,754 in winter and decrease DUDs by at least 3,290,786 during spring migration significantly reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988). Increased DUDs indicated by WAM during December and January for both basins are the result of ponding in the sump as specified by the operational plan. Those potential gains, however, are very questionable.

Traditional use of wintering waterfowl habitats in southeast Missouri is closely linked to the relative wetness (i.e., rainfall) within the regions during late October through January (Bellrose and Crompton 1970, Nichols et al. 1983). Forty-nine hundred acres of ponded water in an otherwise dry St. Johns basin and New Madrid Floodway is a relatively small tract of habitat to migrating waterfowl. For example, over the last several years, the Eagles Nest Wetland Reserve Program tract and rice fields on Hunter Farms have been annually flooded using pumps during fall and winter for hunting. Those habitats, however, receive significantly less waterfowl use in dry years than in years when the region is wet (D. Wissehr and B. Allen, MDC, pers. comm.). Under the proposed alternatives, bottomland hardwoods in the sump area would be flooded annually to great depths for extended periods. Such inundation is detrimental to bottomland hardwood species (Fredrickson and Batema 1992) and could undermine their long-term survival. Moreover, the WAM assumed current forested and herbaceous wetland area would increase with additional

WRP lands. In reality, disconnection from the river and increased drainage will likely result in few additional WRP tracts and additional conversion of wetland to cropland in much of the project area. In light of the above, we strongly recommend that the operational plan be altered to allow for the greatest possible diversity of flood timing, duration, and depth November through March. We believe such a plan would realize more benefits to waterfowl, as well as other species. Altering the operational plan would also allow the river to ebb and flow into both basins during that time, also greatly benefitting fisheries resources by maintaining connectivity between the river and its floodplain.

The WAM does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, pers. comm.). Furthermore, the WAM does not consider other forested wetland habitat components necessary for healthy waterfowl populations. During spring migration, waterfowl are forming pairs, molting, and preparing to breed (Heitmeyer 1985). Forested wetlands fulfill special seasonal waterfowl habitat requirements not found in open land (i.e., moist soil areas and farmed wetlands). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Both project alternatives would eliminate backwater flooding on thousands of acres of forested wetland and moist soil areas during spring migration, significantly reducing habitat that provides necessary protein sources particularly important to waterfowl at that time of year. Under existing conditions, those waterfowl acres occur during spring flooding and are distributed over up to 75,000 acres. Large flooded areas such as those are critical for waterfowl, especially as they form breeding pairs. Because of the differing seasonal habitat requirements of waterfowl, potential fall migration and winter habitat benefits cannot replace significant spring migration habitat losses that would occur with either project alternative. A similar situation would be trying to plant corn during November, December, and January, assuming the same acreage provides similar value to that crop regardless of the season.

The TSP would also negatively affect forested wetland habitat value for other wildlife. Channel enlargement will include clearing large portions of the riparian corridor within the channel work rights-of-way and, in some reaches, removing the banks to enlarge the channel. A narrow berm would be constructed adjacent to the new channel, seeded and periodically maintained. An elevated spoil area would be located landslide of the berm. The Corps modeled direct impacts with assumption that a protective easement will be placed over the construction rights-of-way for channel work in the St. Johns basin and the levee closure in the Floodway, and that berm maintenance along the enlarged ditches will be minimal, allowing all rights-of-way to revegetate naturally. Levee construction will directly affect only a small acreage of forested wetlands in the Floodway.

The indirect effects of the TSP will be far greater on plant communities, particularly in the Floodway. The Service has not been involved in the updated HEP analyses, including model assumptions and applications, so has not had an opportunity to develop quantitative habitat losses using the most recent hydrology. However, qualitatively, the Service believes implementation of either project alternative will lead to conversion of significant tracts of forested wetlands that are no longer subject to backwater flooding. Based on historic and existing land use patterns, and the enhanced drainage system throughout the project area, the 1998 HEP team originally predicted that most of privately owned forested wetlands no longer subject to riverine flooding (because of the project) would be converted to another land use over the 50-year project life. That acreage excluded lands enrolled in WRP and wetland mitigation tracts anticipated to be managed as forests.

All wildlife evaluation species are expected to have significant losses in habitat due to induced wetland impacts. In addition to impacts that can be quantified through HEP analyses, wildlife using the remaining forested tracts will also be negatively affected by increasing forest fragmentation which is particularly detrimental to certain neotropical migratory bird species (Robbins et al 1989, Askins et al. 1990). Fragmentation can lead to higher rates of nest parasitism and competition from bird species that prefer edge habitat.

Three species (i.e., muskrat, red-winged blackbird, and great blue heron) were used to evaluate project-related changes in marsh habitat values. Most of the marsh in the study area is found in the New Madrid Floodway, primarily along borrow pits. The HEP analysis assumed those acres would remain the same because those areas should receive enough rainfall and runoff to maintain marsh vegetation. Based on that assumption, HEP results indicate that project-related changes in marsh habitat values will be insignificant. Proposed deeper ditches and a lower water table coupled with removal of river backwater could invalidate that assumption.

To quantify project-related changes in shorebird migration habitat value, a HEP-based model was developed by the Corps (Appendix H part 1). Shorebird habitat is generally considered that area shallowly flooded (>0.2 foot), with declining suitability in depths between 0.2 and 0.5 feet. Appendix H part 1 did not include additional appendices with model results identified by the author, nor the assumptions in cropping pattern. Therefore, the Service referred to the DEIS text to summarize project-related effects.

Implementation of the TSP would significantly reduce shorebird migration habitat value in both basins:

(Expressed in optimal equivalent shorebird acres).

	Spring	% net change	Fall	% net change
St. Johns Bayou basin	116.46	-31.4	5.68	-39.4
New Madrid Floodway	614.67	-71.1	23.39	-97.1
Total study area	731.13		29.07	

In the New Madrid Floodway, the TSP would nearly eliminate shorebird habitat in the fall. In addition, the TSP would greatly lower water levels in April and May (up to eight feet), significantly reducing of the suitable shorebird habitat acreage in the years following project completion. It is important to note that the shorebird HEP analyses address only spring migration habitat. In years when high river stages occur in June and July (e.g., 1993, 1995, 1996, 1997, 2008, 2011), backwater flooding and the thousands of acres of ephemeral ponds left behind provide important habitat for shorebirds which begin migrating south in late July and early August.

Project implementation is also expected to negatively affect reptiles and amphibians in the project area. Eliminating seasonal backwater flooding over thousands of acres, and the ephemeral ponds that remain after flood waters recede will significantly reduce suitable habitat for reptiles and amphibians, particularly during spring breeding. In addition, project-related changes to surface water patterns may eliminate ponding in many areas in all but the wettest years. This would not only reduce available habitat, but further fragment and isolate tracts of remaining habitat and their reptile and amphibian populations.

Aquatic Wildlife Resources

The most significant project impact to aquatic resources is the loss of seasonal flooding in the St. Johns and New Madrid basins. Under the TSP, the levee closure and pumping operations will eliminate Mississippi River backwaters from entering the New Madrid Floodway and significantly reduce interior flooding in both basins. That, in turn, reduces spawning and rearing habitat for river and floodplain fishes. Killgore and Hoover (1998) used HEP procedures to quantify project-related reductions in flooding on fish spawning and rearing habitat in both basins. The Fish HEP is based on inundation and habitat type only. The Corps most recent analyses apply results of a study of fish access in the St. Johns Basin to modify the results of the Fish HEP, and estimate the effects of both the levee closure and pumping operations on fisheries in the project area. As previously noted, the Service was not involved in the most recent analyses, model assumptions and applications. Therefore we refer to the Corps results presented in the text, with additional recommendations to more accurately evaluate project-related impacts to fish. The Service views the post-project results as overestimates of fisheries benefits in the Floodway for reasons detailed below. Also as noted above, failure to include any analyses of fisheries benefits of events greater than the 5-year flood (only the 2-year event for farmed wetlands) is significantly underestimating current floodplain value, particularly for species that appear to rely on larger events for recruitment (e.g., paddlefish).

According to Corps modeling rearing habitat in the St. Johns Bayou basin will be reduced from 13,356.4 to 11,280.6 functional floodplain acres (excludes farmed wetlands above the 2-year flood elevation) with the TSP. That lost acreage represents 1082.2 HUs. Floodplain habitat losses are substantially higher in the Floodway. Functional floodplain acres would be reduced by 23,478.6, representing 4,956.4 HU s. During the spawning period, it is expected that the gravity gates at the levee closure will remain open until the water level reaches an elevation of 286 feet NGVD in the New Madrid (on average of 18.2 in March, and 16.4 days in April) which will allow for some fish access. It is unknown whether such actions will ensure fisheries access to the Floodway because fish movement through structures (e.g., box culverts) can be confounded by high velocities, restricted openings, and head differentials.

Although the Corps attempted to estimate future fish movement through the proposed New Madrid drainage structure, their study fell short in a number of ways. First and foremost, as designed the study cannot not quantitatively compare the currently unimpeded access of the New Madrid

Floodway with the existing conditions in the St. Johns Bayou which has a drainage structure. Not only did not study fail to sample fish access in the Floodway to provide a baseline for comparison, but the study did not attempt to sample recruitment which is one of the primary outputs from spawning and rearing. The conclusions regarding differences in fish communities in both basins are not well supported (See Appendix C for detailed technical comments). In addition, the relevance of the reproductive guilds is not explained. Given the limited sampling, conclusions based on relative abundance and composition of fish communities in the basins may be premature. For example, study results indicate half the fishes collected in the St. Johns Basin were non-native, highly tolerant western mosquitofish, almost twice as abundant as in the New Madrid Floodway. General conclusions about relative habitat value do not appear to a study objective, are no support by the data and thus are not convincingly presented.

Spawning and rearing habitat losses quantified in the HEP analysis were based on average annual acres of fisheries habitat at and below 2-year frequency flood for agricultural lands and a 5-year frequency for other lands (U.S. Army Corps of Engineers 2013). The acres of floodplain habitat that are inundated during larger flood events can be far higher. While such flooding occurs less frequently, a substantially greater portion of floodplain habitat is available to fish during those events. For example, a 10-year flood event can inundate approximately 70,000 acres in the New Madrid Floodway and benefit fish by greatly increasing available spawning and rearing habitat, as well as primary and secondary productivity associated with those areas. It should be noted that habitat losses associated with permanent waterbodies may be overestimated under both alternatives. Although those areas will no longer be available to riverine fish, they will continue to provide habitat for resident fish.

Severing the link between the New Madrid Floodway the Mississippi River will deprive the riverine ecosystem of productivity that is released by the floodplain during periods of high water from its only remaining connected tributary floodplain in Missouri. Bryan and Sabins (1979) attributed the productivity and resiliency of the populations of commercial and sport [fish] species in the Atchafalaya Basin to wide variations in annual water level that was the transport mechanism for distribution of nutrients to support the food web. River fishes, such as white bass, will lose most, if not all the extensive spawning, rearing, and foraging habitat provided by the Floodway. Numerous studies have examined the relationship between floodplain habitat and fisheries productivity. Lambou (1962) noted over 50 years ago that the timing and extent of overflow on the floodplain can significantly affect year class strength of fishes. Barnickol and Starrett (1951) documented a reduction in game fish in a reach of the Mississippi River with reduced backwater habitat. As one of many more recent examples, Dutterer et al. (2012) again confirmed that reduced floodplain inundation reduces stream fish recruitment in river-floodplain ecosystems, and Janáč et al. (2010) highlighted the benefits of long inundation periods over flooded terrestrial vegetation as protective shelter for survival of native age-0 fishes. Expansive floodplains with a capacity for a wide range of flood elevation potential and long inundation periods will promote recruitment of fishes that use floodplains as nursery habitat.

Eliminating fish access to floodplain areas can also alter the composition of river fish communities by limiting recruitment of certain species (Turner et al. 1994). For example, the plains minnow (*Hybognathus placitus*), Western silvery minnow (*H. argyritis*) and Mississippi silvery minnow (*H. nuchalis*) are rare in the contemporary lower Missouri River where the channel is disconnected from the floodplain (Ridenour et al. 2012a). Levees in southeastern Missouri are associated with reduced fish diversity and abundance of characteristic floodplain species such as starhead topminnow, banded pygmy sunfish and bantam sunfish (Finger and Stewart 1978, as cited in Hoover and Killgore 1998). A 100 percent reduction in fishery value occurred where adjoining backwaters along the lower Colorado River were drained (Beland 1953). Karr and Schlosser (1978) suggested that standing fish stocks may decline as much as 98 percent when floodplains are disconnected from the channel.

Even archetypical big river species like sturgeon chub (*Macrhybopsis gelida*) that inhabit the main channel of rivers during most of their life history are negatively impacted by reduced connectivity because their young experience ontogenetic shifts through slow backwater-like habitat adjacent to the river channel for nursery to improve recruitment opportunity (Ridenour et al. 2009). Further, because *Macrhybopsis* spp. chubs have been reported to make up to 79 percent of pallid sturgeon diet (Gerrity et al. 2006), they represent an important link in the food web that ties survival of a federally listed fish that may never directly use the floodplain during its life history cycle to the functional processes and productivity of connected floodplains and backwater habitats. Given the significant project-related decrease in the extent and variability of fIoodplain habitat that would be available, it is likely that both floodplain resident and main river channel fishes will decline as a result of project implementation.

The loss of fish spawning and rearing habitat in the project area could potentially affect freshwater mussel populations through alteration of the fish community. Mussels are susceptible to such changes because their life cycle includes an obligatory parasitic stage on fish. The larval stage (glochidia) of mussels must attach to the appropriate fish host to complete development (Neves 1993). The representative fish species used by Killgore and Hoover (1998) to report the losses in spawning and rearing habitat described previously include largemouth bass, white crappie, channel catfish and freshwater drum. Those fish species are important hosts for the majority of mussel species found in the project area. Several species, including the abundant threeridge, use sunfish (i.e., largemouth bass, bluegill and white crappie) as hosts. Catfishes serve as hosts for members of the genus *Quadrula*, and the yellow sandshell utilize gar. Several species appear to rely solely on freshwater drum. These include *Leptodea*, *Potamilus*, and *Truncilla* species. Currently, those fish species are common in the project area. Reduction or loss of those fish populations and suitable habitat, however, could potentially reduce recruitment into, or exchange among mussel populations throughout the project-area.

Unquantified hydrologic changes associated with the proposed channel widening may create unsuitable conditions for some aquatic life. The reduced water depths, uniform shaping and smoothing of the channel for flow conveyance, and loss of woody debris will decrease habitat diversity and food supplies for the fish community in St. Johns Bayou, and in some cases could make certain ditch reaches completely unusable by fish. The TSP would significantly reduce riparian forests in the St. Johns Bayou basin. Maximum water temperatures may increase substantially because of increased light absorption through removal of riparian corridor, decreased current, decreased water depths, and expanded surface water (Ebert 1993). Stern and Stern (1980) documented summer temperatures up to 12.8 degrees Celsius (E C) warmer and winter temperatures 4EC cooler in farm streams than in similar woodland streams. Similar patterns in unforested stream reaches have been noted by Hansen (1971) and Karr and Schlosser (1978). In addition, removal of the riparian corridor will reduce influxes of leaf litter to the aquatic community. Such influxes are the primary energy source for instream communities (Brinson et al. 1981). Brinson et al. (1981) note that because of shading and organic inputs, riparian vegetation plays a profound role in the structure of invertebrate communities, and indirectly in fish community structure. Because project implementation will remove (temporarily or permanently) much of the riparian forests in St. Johns Bayou basin (and to a lesser extent in the Floodway) aquatic communities are expected to be negatively affected as well.

Project-area ditches have been periodically dredged to maintain adequate drainage. Unfortunately, the timing of the faunal population recovery and species succession following dredging in those ditches is unknown. The altered environmental conditions left by dredging may benefit some species, but may threaten the existence of many others including those endemic to this region. Dredging can disrupt the entire aquatic ecosystem and cause significant losses of biodiversity. The process removes macroinvertebrate assemblages and trapped organic matter that form integral parts of the trophic web (Cummings et al. 1973, Ebert 1993). Habitat heterogeneity is reduced by the elimination of instream cover (i.e., woody debris and vegetation) which is important to the production and diversity of both invertebrates and fish (Benke et al. 1985, Marzolf 1978, Cobb and Kaufman 1993).

Other effects of dredging extend beyond the excavated area. Aquatic organisms may be adversely affected by burial, exposure to contaminants, increased turbidity, and decreased dissolved oxygen levels (Ebert 1993). Headcutting, the upstream progression of bank erosion and substrate destabilization, has occurred following dredging in low-gradient ditches similar to those found in the project area (Hartfield 1993). Headcutting has been associated with the following: extensive bank erosion; wide, degraded channels; meander cutoffs; whole trees within the channel; quicksand or otherwise loose, unstable sediments; perched tributaries at low water; and the absence of bald cypress and tupelo trees where those species are characteristic components of stable riparian ecosystems.

Dredging and widening in the St. Johns Basin will also severely impact the local mussel fauna. The most direct effect will be the physical removal and destruction of the majority of mussels in the dredge path. Potentially, some individual mussels could be missed by the dredge and survive. Barnhart (1998) found a number of mussels in Setback Levee Ditch whose ages predated the last dredging event. Those individuals were generally found along the wooded bank at sites where only one side was cleared at the time of the dredging. Since the proposed project also involves widening, the impacts to mussel are likely to be far more extensive than past dredging events.

As noted previously, the mussel assemblage in the proposed project area appears to be particularly vulnerable to dredging and channel maintenance as shown by the greatly reduced mussel populations in project-area ditched over the last 15 years (U.S. Army Corps of Engineers 2013). Twenty of the 24 species found by Barnhart (1998) each made up less than 5 percent of the 1998 individual mussels collected. A large-scale disturbance, such as dredging, has the potential to cause localized extirpation of some mussel species.

Since mussels are relatively immobile, recovery of depleted populations will depend upon recruitment of juveniles transported by fish hosts from adjacent populations unaffected by the dredging. Those "seed" populations would largely be restricted to the upper Setback Levee Ditch and the St. Johns Ditch. The mussels in those areas are relatively less abundant and species rich compared to the proposed dredged area. It is uncertain whether the Lee Rowe Ditch would serve as an adequate seed population. Although this ditch is not in the proposed dredge path, it may be severely altered. Dredging will lower the bottom of the Setback Levee Ditch and St. James Ditch. As a result, the Lee Rowe Ditch could become perched during base flows resulting in decreased water velocity. The natural succession to follow may transform this area into a more lentic environment suitable for very few mussel species (Fuller 1974, Oesch 1995).

The timing of the population recovery and species succession following dredging in lowland ditches is unknown. The degraded habitat left by the dredging is unlikely to be suitable for colonization by juvenile mussels and may require several years to recover. Since mussels are obligate parasites of fish, the recovery of specific host populations is a prerequisite to the restoration of habitat for juveniles. Considerable time may be required to restore adequate spawning habitat (i.e., snags and aquatic vegetation) for these fishes.

Endangered Species

Two federally listed species occur in the project area: the pallid sturgeon and the Interior least tern. Project implementation will significantly reduce backwater flooding in the project area during spring, particularly in the New Madrid Floodway. That, in turn, will virtually eliminate seasonal use of the floodplain by Mississippi River fishes. Several least tern colonies occur adjacent to and downstream of the project area. Because of the importance of fish in the diets of both species, significant project-related impacts to fisheries production may also affect those species. The Corps has submitted a Biological Assessment to the Service and requested formal consultation on those species. The Service has concurred with the Corps that the project is not likely to adversely affect the pallid sturgeon based on insignificant effects (i.e., effects that cannot be meaningfully measured or detected.). The Service prepared a May 2013 draft biological opinion on project effects to the least tern. In that biological opinion, the Service determined that the project is likely to adversely affect the interior least tern, and we developed a list of reasonable and prudent measures to minimize incidental take.

Fish and Wildlife Conservation Measures

The proposed project alternatives will have significant adverse impacts on fish and wildlife resources. The TSP will have substantial direct effects on fish and wildlife. Of equal or greater concern are the indirect, project-related hydrological changes that will result in degradation and loss of fish and wildlife habitat due to the levee closure and pumping operations. Closing the gap in the New Madrid Floodway will severe the link between the Mississippi River and its only connected tributary-floodplain complex in Missouri. The riverine ecosystem will lose the productivity that is released by the floodplain during high water. River fishes, such as white bass, will lose 100 percent of the extensive spawning, rearing, and foraging habitat provided by the Floodway. Because of the significant project-related impacts to fish and wildlife resources, the Service believes that project plans can and should be further modified to mitigate those negative impacts.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

> (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the actions; and (e) compensation for the impact by replacing or providing substitute resources or environments.

The Service's Mitigation Policy (U.S. Fish and Wildlife Service 1981) supports and adopts that definition of mitigation and considers its specific elements to represent the proper sequence of steps in the mitigation planning process. That policy identifies four resource categories to ensure that the level of mitigation recommended by Service biologists is consistent with the fish and wildlife resources affected by the project. Considering the high fish and wildlife value and relative scarcity of the forested wetlands to be impacted by the proposed project, those habitats have been designated Resource Category 2 habitats. The upper ditch reaches in the St. Johns basin contain valuable instream habitat (i.e. logs, debris, and submerged vegetation) and support diverse freshwater mussel populations which are becoming rare both regionally and nationally, and thus are also considered Resource Category 2. The mitigation goal for that resource category is no net loss of in-kind habitat value. The majority of wetlands in the project area are composed of croplands, pasture, and fallow fields. Because those wetlands provide high to medium habitat value to fish and wildlife, and are relatively abundant nationally, those habitats are considered Resource Category 3 with the mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value. What makes those areas especially important to fish and wildlife is periodic inundation during high river stages. In fact, backwater flooding is a critical factor in determining the habitat value of most of the wetlands in the project area. Such flooding provides not only habitat, but also makes floodplain productivity accessible to the riverine system. Unfortunately, such systems are also becoming increasingly scarce at both the regional and national level. Gore and Shield (1995) noted that the stability and functioning of large river ecosystems depends on maintaining watershed and floodplain integrity. Consequently, mitigation measures should ensure, to the maximum extent possible, continued connectivity between the floodplain and the river to maintain the functions of those habitats and the ecologic integrity of the floodplain-river ecosystem.

Wetlands

While the Service, Corps and MDC planning team initially agreed to use HEP procedures to capture project-related losses to fish and wildlife, as well as potential benefits of various mitigation measures, the Corps' more recent analyses were not conducted collaboratively with the planning team. Thus using the Corps' fish and wildlife habitat modeling results leaves out significant losses of wetland functions not included in either the Corps' HGM or the species models. Therefore, the Service provides the following comments as context for mitigation recommendations for wetlands.

The Corps used the HGM and the Missouri Stream Mitigation Method (MSMM) to determine project impacts on wetlands and streams, respectively (U.S. Army Corps of Engineers 2013). The HGM method is not being used in Missouri to evaluate project impacts and compensatory mitigation under Section 404 of the Clean Water Act because it involves multiple assumptions and complex computations making complicated to use and difficult to interpret. In addition, there are no protocols within the method for tradeoffs among wetland types. That, coupled with its limited application (i.e., not applied to all wetlands in the project area) for this project do not provide a credible wetlands functional evaluation in the Service's opinion, In addition, we believe the public will find the HGM and its results almost indecipherable, failing one of the fundamental objectives of the DEIS.

An Interagency Review Team (IRT) made up of the Corps, EPA, the Service, NRCS, MDC, and the MDNR has developed the Missouri Stream Mitigation Method (MSMM). The IRT is also developing the Missouri Wetland Assessment Method (MWAM) still in draft form. The two methods will serve as the preferred method for quantifying unavoidable stream and wetland impacts associated with the Section 404 permit applications as well as compensatory mitigation benefits.

Aquatic resource types under the MSMM are based on the suite of functions provided by the habitat under consideration. For example, using the MWAM, the acreage required to compensate for the draining of forested wetlands in the project area could be up to 11.25 times the affected acreage**.** Those areas are considered a Type A habitat (multiplying factor of 3) in a primary priority category (waters officially designated by the Corps as high priority, multiplying factor of 2) that are lightly impaired to fully functional would (multiplying factor of 2.25), with duration of impacts to last over 10 years (temporal lag) (multiplying factor of 2) and a dominant impact of draining (multiplying fact of 2).

MDNR developed the Aquatic Resources Mitigation Guidelines with the cooperation of the MDC, EPA, the Service, NRCS and the COE. Compensation ratios for project impacts are between 1 - 3 times the affected acreage for emergent wetlands, and 2 -5 times for forested wetlands. These ratios may be increased when mitigation is not conducted before or concurrently with a development project, out-of-watershed mitigation is required, and when projects impact functioning mitigation sites (as is the case in the Floodway). MDNR's guidelines also indicate that rare and unique aquatic habitats may not be appropriate for any mitigation and therefore no impacts should occur in these areas. These areas include fens, mature bottomland woodland, or other areas as described by the NRCS Missouri categorical exclusion and "red flag**"** areas, including Bootheel forested wetlands. This is yet another reason why MDNR should be included in development of the compensatory mitigation plan before it is proposed for public review and input.

Mitigation in batture lands would not adequately compensate for wetland losses. Batture lands are already connected to the Mississippi River and subject to the flood pulse. Much of the batture is wetland already, although many areas experience far harsher velocities and temperatures that the adjacent floodplain wetlands. The Corps' compensatory mitigation package does not demonstrate compliance with the Compensatory Mitigation Final Rule because of the uncertainties surrounding the timing, location, duration and nature of the mitigation measures.

The Service reviewed the Adverse Impact Factors for Riverine Systems Worksheet, the In-stream Work Stream Channel/Stream Restoration or Enhancement and Relocation Worksheet and the Riparian Buffer Creation, Enhancement, Restoration and Preservation Worksheet. There is little or no supportive information showing how numbers were put into the worksheet. The worksheet indicated that approximately 15 miles of stream would be adversely impacted and the DEIS stated channel work would occur in 23 miles of stream. If impacts will occur in 23 miles of stream, then mitigation credits required would increase to 1,045,656. The DEIS does not show how recurring impacts would occur in Type 3 and 4.

There is little or no supportive information to show how the Corps determined the net benefit, monitoring/contingency, control/site protection, mitigation construction timing in the DEIS. In Section 6.3, Compliance with Mitigation Rule, the stream restoration is described as:

1. Construction nine transverse dikes in the lower 3.7 miles of St. Johns Bayou to create a low flow sinuous channel following construction.
2. Construct a bank stability structure at the confluence of St. Johns Bayou and Setback Levee Ditch to provide stability and structure.
3. Construct a bank stability structure at the confluence of Setback Levee Ditch and St. James Ditch.
4. Incorporate stable stream slopes along channel rights-of-ways.

We do not agree that the net benefits for items 1 and 2 should be 2 (rated as good). The stream enhancement activities are more accurately described as moderate (1.0). Only construction of the transverse dikes would provide an ecological lift to the stream system. We question whether the sinuosity pattern in the channel would be allowed to persist or if periodic "channel cleanout" as is described in the project, would affect that feature. Restoration activities 2-4 are considered best management practices that would be required of any stream construction activity, and thus the project should not receive any restoration/enhancement credits for activities 2-4. Therefore, only credits should be allotted for the lower 3.7 miles of the project.

Woody vegetation will be planted on one side of the channel and warm season grasses on the other side of the channel for approximately 159,318 lineal feet of the stream. In Section 6.3, Compliance with the mitigation rule, the riparian buffer creation/enhancement is described as establishing buffer strips along the right-of way as:

1. Ditches would be excavated from one side. Excavated material disposal piles would be placed a minimum of 40 feet from the newly constructed top bank. Spoil piles would be allowed to revegetate naturally. Spoil piles would be used for any future ditch maintenance.
2. Within the 40-foot berm, warm season grasses would be planted to create a grass buffer. This grass buffer strip would be maintained and would serve as future maintenance/inspection access.
3. A riparian buffer would be created along the opposite bank by the establishment and or preservation of woody vegetation.

We do not believe the side of the channel where grasses will be planted should receive any mitigation credit. The 40-foot wide strip would be "maintained," which we assume means mowed, and will be used for future maintenance/inspection access. Historically, the Bootheel was bottomland forested habitat and any riparian restoration should be limited to revegetating with woody species. A twenty-five foot wide woody riparian corridor provides little habitat benefits along a perennial stream. The IRT generally recommends a minimum100-foot buffer along perennial streams. The Corps must provide supportive information with the assessment to verify the credits and debits in report. Ideally, they should include the IRT in project analyses for these assessment tools, and also recalculate debits and credits based on our recommendation.

St. Johns Bayou Basin

According to the Corps, the New Madrid Floodway is hydrologically separate from the St. Johns basin. Therefore, flood control efforts in the Floodway would not address flood damage in and around East Prairie. The Service and MDC fully support measures to protect homes, businesses, and public infrastructure from flooding. However, we believe there are several alternatives to better address flooding problems in and around East Prairie that would avoid all or most of the adverse environmental impacts associated with the proposed alternatives. According to the Corps, local drainage improvements are necessary to significantly reduce municipal flooding. The Service has previously recommended several measures regarding alternate pump operations and non-structural alternatives. Such measures would avoid fish and wildlife impacts in the St. Johns Bayou basin associated with channel enlargement and lower water levels while ensuring the public safety. Focusing flood risk reduction efforts on public infrastructure and urban areas in the St. Johns Basin only, would also avoid adverse impacts to the New Madrid Floodway and retain the connectivity between the Floodway and the Mississippi River, as well as the habitat values and functions of the system.

If the Corps determines that more extensive work is necessary to reduce flooding in East Prairie, such work should be limited to that basin. Channel enlargement impacts to both the riparian corridor and in-stream habitat along the St. James and Setback Levee ditches, and St. Johns Bayou should be minimized to the greatest extent possible. The TSP would avoid some impacts to the riparian corridor by limiting channel enlargement of the St. Johns Bayou to 120 feet, and working from only one bank, switching work in the St. James Ditch to the right bank between Missouri Highways 80 and OO. The Corps has proposed construction of transverse dikes every half mile on alternating banks in the lower four miles of St. Johns Bayou to mitigate for in-stream habitat losses. Such dikes are reported to create a more natural stream morphology and provide riverbank habitat (Killgore and Hoover 1998). Before such measures can be fully evaluated, however, it should be determined whether sedimentation will occur between the rocks, which would reduce the habitat quality of those structures.

No mitigation measures have been proposed by the Corps to compensate for in-stream habitat losses in the Setback Levee or St. James ditches. Vortex weirs, a relatively new technology to provide in-stream cover, have been proposed by MDC (Mark Boone, pers. comm.). Vortex weirs are a low-head structure consisting of series of large rocks or boulders anchored across the channel. The rocks are spaced apart to allow water to flow through. Vortex weirs have been used successfully in streams with high bedloads (similar to the project area ditches) because they allow sediment transport. In addition to providing habitat for host fishes, the weirs may also create habitat for freshwater mussels by providing substrate stability and a wide range of current velocities without creating backwater and sediment deposition which most species of unionids cannot tolerate (Fuller 1974). MDC recommends the weirs to be a minimum of 25 feet long and installed every 0.25 miles.

The TSP would avoid the upper 3.7 miles of the St. James Ditch to protect the aquatic vegetation that provides habitat for the golden topminnow. While this will leave the upper reach of habitat intact, additional habitat may still be affected downstream. Similar habitat occurs in the St. James ditch as far south as County Road 525. In that reach, Service and MDC biologists observed another rare species, the northern starhead topminnow, which has similar habitat requirements. Because the range of the topminnow species and its habitat in the project area have not been determined, and it is uncertain if that habitat will reestablish itself after dredging, the Corps should minimize dredging and channel modifications in the entire reach of St. James Ditch that contains the topminnow's preferred habitat (i.e., quite waters with aquatic vegetation).

Several additional actions could be taken by the Corps to mitigate loss of aquatic habitat diversity, shallower water depths, higher water temperatures during the low flows, headcutting, and perching caused by channel enlargements. Transverse dikes could be constructed to offset losses from a shallower, wider channel in all work reaches. The dikes should be designed to scour a continuous, sinuous thalweg along the entire channel. The Corps has proposed such structures in the lower four miles of St. Johns Bayou (discussed previously), but as a means to create riverbank habitat. The reaches that will be affected most by reduced water depths will be the Setback Levee and St. James ditches.

Gradient control structures to prevent headcutting should be placed at the upper end of all work reaches including the St. James and Setback Levee ditches. Those structures should also be placed at the mouth of all major tributaries including the St. Johns and Lee Rowe ditches. Vortex weirs, discussed previously as a means to create in-stream fish habitat, are also designed to provide gradient control. Therefore, installing weirs may compensate for habitat losses as well as prevent headcutting. A low water weir should also be installed where the Lee Rowe Ditch branches off St. James Ditch to prevent perching this channel during base flows. Without these measures, aquatic habitat losses from dredging and channel widening will go unmitigated.

The dredging plan should also be modified to reduce impacts to freshwater mussels. Of the reaches surveyed in the project area, the Setback Levee ditch contained the highest mussel diversity and abundance (Barnhart 1998). Most individuals collected from that ditch were in a 6.5-foot strip along the wooded bank (right descending side). To reduce impacts to mussels and increase the potential for recolonization, at least a 9-foot strip along the right descending side of the channel should be avoided entirely. This measure is intended to leave enough mussel breeding stock to repopulate the dredged reaches. (It should be noted that avoiding one side of the ditch would also minimize negative impacts to wildlife such as wading birds, mink, otter, and numerous reptiles and amphibians.) Because survival of mussels in that strip is uncertain, that effort should be supplemented with mussel relocation from sites within the dredge path to other areas in the project area. In addition, a monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of mussel mitigation measures. Although the dikes, weirs, and gradient control structures all have potential to provide suitable mussel habitat, mussel use of those structures has not been evaluated. Therefore, the mussel monitoring plan should also include long-term monitoring to determine the value of those structures as mussel habitat. The monitoring program should quantify changes in population densities and habitat conditions over time and determine the timing of population recovery in dredged reaches. Given the longevity of unionids, populations should be monitored prior to project construction and for at least 15 years post project. That timeframe should be sufficient to document mussel recolonization, if any occurs. The information gained from that study could be used to better evaluate and manage impacts to mussels in future projects.

New Madrid Floodway

The proposed work in the New Madrid Floodway will have significant negative effects on fish and wildlife resources. Therefore, if the Corps determines that flood control measures are required in the Floodway, we strongly encourage them to consider other alternatives that would avoid most of the adverse environmental impacts associated with either of the proposed alternatives. For example, a non-structural alternative such as the use of flood easements in the lower portion of the Floodway could reduce flood-related agricultural damages while ensuring that area will continue to provide habitat to nationally significant fish and wildlife resources. (That measure could also be considered for the St. Johns Basin.) The Service has recently learned of efforts coordinated by the Business Council for Sustainable Development, Gulf of Mexico, to reforest up to 1 million acres of marginal farmlands in the lower Mississippi River Valley. The goals of the program are to improve water quality, recreation, and fish and wildlife habitat; provide an economically viable alternative to farming flood-prone lands; ensure adequate future supplies of forestry products, and provide communities with a sustainable way to diversify their economic base. The Service strongly supports such efforts and believes the Corps should further consider this and similar efforts as a way to reduce flood damages in the project area while enhancing fish and wildlife resources, and providing diverse, sustainable benefits to the local and regional economies.

The Service and MDC have previously recommended alternative alignments of the levee closure to preserve thousands of acres of floodplain as habitat for numerous fish and wildlife, and also maintain the ecologic functions (e.g., primary and secondary productivity export to the river, flood water storage, etc.) of floodplain wetlands by ensuring hydrologic connectivity between the floodplain and the river.

The TSP would have significant impacts to fish and wildlife in the Floodway. The Service and MDC, however, believe there are additional measures that would further reduce fish and wildlife impacts. In the TSP, the drainage structures will remain open in the St. Johns basin and New Madrid Floodway an average of 14.4 and 12.9 days (i.e., the average number of days interior water levels are expected to be higher than river stages, and thus allow drainage to the river) in March and April respectively. Although that operation plan potentially provides Mississippi River fish limited access to floodplain habitats during part of the spawning season, the extent of fish movement through the box culverts is unknown. Furthermore, that alternative would still cause significant losses of floodplain spawning and rearing habitat. If river fish were able to access those basins, little if any of the existing floodplain would be inundated at that time under either proposed project alternative. Of the proposed Floodway closure alternatives, the Service recommends alternative 4.1 as the alternative with the fewest adverse impacts on fish and wildlife resources, including minimized anticipated take of the federally listed Interior least tern.

St. Johns Bayou Basin and New Madrid Floodway

The most effective measures to mitigate project impacts would maintain the natural connectivity and water level variability of the floodplain which, in turn, would protect the ecologic functions of project-area wetlands. The Service has suggested to the Corps that the pumps be operated according to a "Rule Curve" that would ensure the greatest interchange possible between the Floodway and the river. Such a plan would have both outlet structures open to allow flooding up to the elevation that avoids inundation of important public infrastructure. Pump operations could be determined that would have specified target elevations during the spring fish spawning season. The purpose of a "Rule Curve" is to use a combination of gate openings, target elevations, and pumping to prevent damaging water levels, while allow some interchange between the river and the Floodway. For example, if river stages exceeded the trigger elevation, the gates could be closed and water levels reduced (via pumping) to (or slightly below) the trigger elevation, so that the gates could be reopened. Such measures would allow for more floodplain-river interchange (and fish and wildlife habitat) in the St. Johns Basin while reducing some of the negative project impacts to the New Madrid Floodway by increasing the time the drainage structures would remain open.

An operational rule curve would also promote the long-term variability in water depths important to wetland invertebrate production, wetland plant response during the growing season, and overall wetland health. In addition, such operations would allow much of the lower basins to flood naturally during wet years when they would have the greatest waterfowl use. In addition to the fish and wildlife benefits, we believe that such a plan has the potential to lower long-term pumping costs in comparison to the proposed plans. Alternative 4.1, which was suggested by the IEPR, appears to minimize losses to fish and wildlife resources while also protecting public infrastructure. The difference in "excess benefits" between the preferred alternative and Alternative 4.1 appear to be within the confidence limits of the methods, thus essentially insignificant.

Because the Service was not involved with the most recent project impact analyses, we have not developed quantitative estimates of compensatory habitat requirements for the proposed project. As previously noted, the Service believes Corps project impacts are significantly underestimated. We will study the current DEIS in greater detail during the public comment period, and provide quantitative estimates of compensatory mitigation needs in our final report. This may require additional information from the Corps to adequately capture all project impacts reasonably certain to occur.

The following sections address qualitatively the mitigation requirements to compensate for project-related losses to fish and wildlife habitat value. Ideally, those measures would be conducted within the affected basin to ensure that wetland and floodplain ecologic functions were conserved in the project area. In this case, however, it will be impossible to compensate habitat losses within the project area. Even with the TSP, fisheries access through the drainage structure to the floodplain will be drastically reduced in the Floodway. The 1,500-foot gap in the levee that currently provides river fish access to floodplain habitats throughout the spring spawning season (i.e., March - June) will be restricted to a single 10-foot by 10-foot box culvert that would be open only periodically during part of the spawning season (i.e., an average of 18.2 and 16.4 days in

March and April respectively), generally during lower river stages. There are no measures within the project area to fully mitigate the loss of the natural connectivity between the Mississippi River and the New Madrid Floodway as a result of the preferred alternative. In addition, after project implementation, not only would fisheries access into the basins be reduced, but suitable habitat would be almost eliminated. In April, during the spring spawning season and waterfowl and shorebird migration, water levels in the project area would reduce average flooded acres in the Floodway by 72%.

Floodplain habitats that will be substantially reduced by the project include cropped agricultural land (CAG) (including farmed wetlands), fallow land, bottomland hardwood forests, and seasonally connected large and small permanent water bodies. The Corps has proposed to convert flooded agricultural land to bottomland hardwood forest to compensate fisheries habitat losses of seasonally inundated CAG, fallow land, and forested wetlands. Since forested wetlands generally have higher fisheries habitat value than seasonally inundated CAG or fallow land, well as wildlife, we believe that re-establishing forested wetlands can be an effective measure to compensate losses of floodplain fisheries habitat losses, provided the site has significant access for riverine fish from March through June (See details on reforestation below). Previous interactions of the fisheries HEP model shows substantial early-season rearing losses in both basins, much of those losses are attributable to changes in white bass habitat. Sheehan (1998), however, did not record white bass in spring sampling in the St. Johns Basin. In addition, according to the HEP model, agricultural fields, rather than forested wetlands, appear to have a higher suitability index for larval white bass, which would derive minimal benefit from reforestation as a compensation measure. Therefore, we believe mid-season habitat losses better reflect habitat changes to a larger number of both floodplain and riverine species, and compensation based on those losses would benefit the majority of the fish fauna.

The Service recommends that rearing acres be mitigated because of their importance to fisheries and their ecological functions. Since little is known of the distribution of larval fishes in floodplain habitats, there has been some debate on the need to mitigate rearing habitat losses of areas less than one foot deep and flooded agriculture fields (including farmed wetlands). However, Ridenour (2007) demonstrated that waters less than one foot deep provided significant nursery habitat for fishes around main-channel sandbars; these extreme shallow waters provided warmer temperature and food resources for fast growth, and provided a refuge from fish predators. Available data on fish use of flooded agricultural fields is varied. Hoover and Killgore (1996) collected larval fish from various floodplain habitats in the Big Sunflower River system in Mississippi. Invasive and ubiquitous species such as carp and shad were most often found on flooded agricultural and fallow land. Other species were concentrated around bottomland hardwoods. In contrast, data from extensive fish sampling of floodplain habitats near Cape Girardeau, Missouri show other fish species use agricultural fields as rearing habitat. In 1993, large numbers of larval fish were collected by trawl from agricultural fields up to 3/4 of a mile away from permanent waterbodies. The most abundant larval fishes were drum, silversides, various species of minnows, and several species of darters (Bob Hrabik, Cape Girardeau Long-term Resource Monitoring Station, pers. comm., 1998). Ridenour et al. (2012b) found age-0 size *Macrhybopsis* spp. chubs were six-times more abundant in sites with connected floodplain backwater areas than sites without connected floodplain backwater areas.

Killgore and Hoover (1996) sampled fishes from the Yazoo River system in Mississippi to quantify the relationship between water depth and larval fishes. From these collections, they concluded that water less than one foot deep was not extensively used by larval fishes in the Yazoo River system in Mississippi. Bob Hrabik (pers. comm.), however, collected various species of minnows from flooded agricultural fields in water less than one foot deep. He believed that larval fish were most likely present in those areas but are not often sampled with common and conventional electroshocking methods. While Yazoo River larval fishes may prefer slightly deeper water, their depth use distribution may be driven by other factors such as pressure from terrestrial and avian predators that often hunt in littoral riparian zones of rivers (Power 1987; Schlosser 1987). Ridenour (2007) concluded that extreme shallow waters, where conventional electroshocking methods are ineffective, do provide significant nursery habitat in main-channel areas for larval and age-0 fishes that are too small to be sampled with conventional electroshocking methods. Extreme shallow waters in floodplains likely also facilitate significant floodplain functions (detrital input, nutrient cycling, floodwater storage, etc.) in their role as part of the aquatic-terrestrial-transition-zone *ATTZ* (Junk et al. 1989). The wide-spread, shallow flooding in the project area provides a large surface area for planktonic production driven by sunlight and warm temperatures. It is generally accepted that floodplain waters (including shallow waters) are important for the production of phytoplankton and zooplankton (Robert Sheehan, pers. comm.), which are the principle food source for larval fish (Pflieger 1997). In addition, a major factor involved in the transition of larval fish from endogenous (yolk sac) to exogenous nutrition is the density of food organisms (Hall and Lambou 1990). As previously mentioned, Hrabik (1994) noted the extremely high zooplankton productivity on a wide floodplain near Cape Girardeau. Because larval fish use shallow-water habitat and because of the contribution of that habitat to the primary and secondary productivity of the floodplain, the Service recommends that all fish rearing habitat losses, including those habitats shallower than one foot deep, be fully compensated. From a practical standpoint, it would be very difficult to ensure that all compensation acres meet the spawning criteria (i.e., flooding > 1 foot for 8 days or more) to replace spawning habitat losses over an area of such small topographic relief. Although water depth and duration depend on the characteristics of a particular site, Corps hydrologic modeling shows that spawning acres account for only a portion of the area inundated under natural flooding patterns. Therefore, achieving the necessary compensation acres to meet the spawning criteria may involve inundating considerably more acreage.

Ideally, mitigation lands should be located in an area currently not subject to flooding, but with potential to restore the hydrology to a functioning forested wetland. The greatest habitat gains would result from reforesting an area that does not flood (hence no existing fisheries value), but has the potential for restored wetland hydrology. Such a site, however, would most likely involve significant water management and fisheries access issues. Locating compensation area(s) on farmed wetlands would provide the hydrology, but result in a net loss of wetland acreage due to the project. In addition, the value of restoration lands designed to compensate lost fisheries habitat differs greatly with location and flooding regime. The estimated acreage is an annual average over the life of the project (consistent with the methods used to assess existing habitat value). That means over the next 50 years, the mitigation tract(s) must provide functions equivalent to those acres, taking into account effects of variable river flooding. For example, a selected track is inundated only 60 percent of the years, then additional acres may be required to provide the remaining 40 percent of the mitigation value necessary to compensate for those habitat losses. It is important to provide mitigation lands as similar as possible to the lands affected. For example, mitigation lands in the batture will not provide the same habitat conditions as backwater and floodplain habitats that are so rare along the Lower Mississippi. As noted above, fisheries communities and life stages differ significantly between the floodplain and main channel of the Mississippi River, and robust native fish communities need both the survive.

Another confounding factor is flooding duration. If the mitigation tracts are inundated March through June, they could potentially compensate for the early, mid, and late spawning and nursery needs. Unfortunately, such an extended flooding period is not compatible with reforestation of bottomland hardwood tree species. Many previous reforestation projects in the lower Mississippi River Valley have met with poor success because of problems with modified flooding regimes that can drown seedlings and/or acorns. Although reforestation benefits many fish species, the proposed compensation acreage will not meet the substantial spawning and rearing needs of the white bass. Flooded cropland and fallow fields provide greater habitat value for that species. Therefore, we recommend that the Corps consider measures to seasonally inundate cropland during the month of March to meet the habitat needs of white bass. Possibly such flooding could also be used to compensate for spring shorebird habitat losses (see below).

The Corps had previously suggested creating borrow pits to partially mitigate for habitat losses of seasonally connected large and small permanent water bodies on the floodplain, including natural oxbow lakes. Although the functional similarity of borrow pits and oxbow lakes is unknown, borrow pits have been shown to function as effective fish nurseries if they are properly constructed (Sabo and Kelso 1991; Tibbs and Galat 1997; Whitledge et al. 2005). The Corps has adopted guidelines for borrow pit construction along the lower Mississippi River (Aggus and Ploskey 1986). Several features important to fisheries are high shoreline to surface-area ratio; various depths, both shallow and deep (as refuge); various substrate materials; and riparian vegetation. Those guidelines stressed the importance of maintaining connections to the Mississippi River so that spawning adults can access the ponds and young-of-the-year fish can escape when conditions in the ponds become stressful. Permanent waterbodies appear to be particularly important as nursery habitat for larval fish (J. Killgore, pers. comm.). Killgore and Hoover (1996) noted that larval fish were found most often in waters greater than 1 foot deep. Because of the expense of borrow pit construction, the Corps' original proposal would result in only a small portion of permanent waterbody habitat losses mitigated in-kind.

More recently, the Corps is recommending reforesting flooded croplands to compensate for permanent waterbody habitat losses. In light of the cost constraints and minimal habitat gains from the proposed borrow pit construction, the Service has agreed to reforestation as an appropriate mitigation measure. Given the importance of permanent waterbody habitat to larval fish, however, we recommend that the Corps provide in-kind habitat compensation for those losses to the maximum extent possible. This could be done by purchasing mitigation lands that include permanent waterbodies that could be improved (i.e., reforest or regrade old borrow pits) or reconnected to the Mississippi River (i.e., old chutes, sloughs, or oxbows). Such areas should allow *significant* fisheries access to riverine species from March through June to realize the estimated habitat benefits. In addition, to compensate for losses to recreational fishing we recommend the Corps ensure public access to those waterbodies through fee-title purchase or easements.

Habitat value of forested wetlands in the project area will decline significantly because of channel enlargement, levee closure, and pumping operations. To compensate for that habitat loss, we recommend that the Corps purchase croplands in fee-title to be reforested. Reforestation can be a very effective and efficient compensation measure. Depending on the location and flooding regime, restoration of forested wetlands could meet the needs of forest wildlife, waterfowl, and fisheries. Ideally, those lands should be located in an area currently not subject to flooding, but with potential to restore the hydrology to a functioning forested wetland. As previously mentioned, locating compensation area(s) on farmed wetlands would result in a net loss of wetland acreage due to the project. In addition, as shown in the fisheries analyses, farmed wetlands have important habitat value and their use would further increase the acreage required to compensate habitat losses. Specific details on species mix and reforestation methods will depend on the location of the compensation site(s) (e.g., soil, flooding regime, size, etc.) and will be developed by the Service and MDC. In general, however, compensation acres should be directly seeded, weeds controlled for a minimum of five years, and 70 percent tree survival attained at the end of five years. If necessary, at the end of five years, the area should be replanted and weed control implemented until the 70 percent survival threshold is met.

It should be noted that full replacement of forested wetland functions will not occur for many years given the time needed to grow large, mature trees. We estimate that it will take at least 50 years for a mitigation site to approach the habitat quality that currently exists in the project area. In addition, using the direct seeding method, the mitigation site will not compensate for lost habitat value for such species as the pileated woodpecker (an evaluation species) which require the large trees and structural complexity found only in mature forested wetlands. There is an experimental method, however, that may provide some of that habitat value within the project life. The root production method (RPM) has been shown to give young trees a several years Ahead start@ (i.e., mast production within 7-10 years)(B. Allen and D. Wissehr, MDC, pers. comm.). Because of this potential and its experimental nature, we recommend that the Corps plant a portion (# 15 percent) of the compensation area with trees subject to RPM to possibly compensate for mature bottomland hardwood forest habitat losses. In rare instances, preservation of an existing high quality tract of forested wetlands may be an acceptable compensation measure. Such cases, however, occur when there is no suitable acreage to reforest. Preservation is another instance where compensating wetland habitat losses with existing wetlands results in a net loss of wetlands in a project area.

We believe there will be significant indirect, project-related effects to forested wetlands because of hydrologic changes (i.e., eliminating seasonal inundation). The Phase I General Design Memorandum for the St. Johns and New Madrid Floodway project recognized the value and vulnerability of remaining forested wetland in the project area (U.S. Army Corps of Engineers 1980). We believe that it is still appropriate to protect important bottomland hardwood wetland habitats in the project area from future conversion. Under any project alternative, the most effective means to avoid the complete loss of forested wetland function within the project area is to maintain hydrologic conditions. Short of that, measure to prevent the conversion of those remaining forested areas through protective covenants can provide significant benefits to fish and wildlife. A restrictive covenant or some other appropriate protective measure should be used to prevent the clearing of all existing unprotected forested wetlands that will no longer be seasonally inundated. Those include privately owned tracts that are not being managed for timber or enrolled in wetlands restoration programs (i.e., WRP). Based on the Corps hydrologic analyses, such measures should cover forested wetlands between elevations 291 and 290.4 feet NGVD in the St. Johns Bayou basin, and 292.1 and 287.6 feet NGVD in the New Madrid Floodway. Those measures would also preserve the habitat value of mature bottomland hardwood forests, which is unlikely to develop on reforested compensation areas over the project life. If the protective measures for forested wetlands mentioned above are not implemented, we recommend that the Corps purchase in fee-title, sufficient croplands to fully compensate habitat losses from induced development of those wetlands.

Implementation of either project alternative will greatly reduce waterfowl habitat values during spring migration. Therefore, we recommend that the Corps re-establish forested wetlands, as previously described, to compensate for those habitat losses. Not only will reforestation meet the food requirement of migrating waterfowl, but forested wetlands will also provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Acres reforested to compensate for bottomland hardwood forest wetland losses could also compensate waterfowl habitat losses, provided the flooding regime and conditions are appropriate. Acreage to compensate for spring waterfowl habitat losses should be flooded only to a depth of 18 to 24 inches to be accessible to most dabbling and diving ducks in the project area.

Spring shorebird migration habitat will also be significantly reduced under either of the proposed project alternatives. In the St. Johns basin, habitat value would decrease approximately 30 percent, while in the Floodway the TSP would cause a 70-90 percent decrease in spring and fall shorebird habitat value respectively. To compensate for those habitat losses, we recommend the Corps secure, either through fee-title or easements, appropriate acreage (that would not be flooded under future project conditions) to be managed for shorebirds during spring and fall migrations. Moist soil areas provide more habitat value per acre than flooded cropland, so fewer compensation acres of that habitat type would be needed. In addition, depending on the depths of and access to an area, shallow flooded croplands or moist soil acreage could be used to offset a small portion of the habitat losses to fisheries and waterfowl. Structures within the existing drainage network in the project area could possibly be used to seasonally trap rainwater on agricultural lands to provide spring shorebird habitat. Alternatively, areas could be engineered, by installing small dikes and pumping systems, to control water levels regardless of precipitation or backwater flooding (i.e., moist soil units). Both those measures, however, would largely reduce or eliminate fisheries access at that site. Furthermore, although shallow water along the edges of borrow ditches may be suitable for shorebirds, existing borrow pits in the project area do not receive much shorebird use (B. Allen and D. Wissehr, MDC, pers. comm.). That may be related to the size of the borrow pits, or the presence of tall riparian vegetation and proximity to the Setback Levee both of which could obstruct the birds long-range vision. ***Regardless of the specific measures employed, use of existing conservation lands to meet compensatory mitigation, as the Corps has proposed, is not acceptable. It contradicts Service policy and guidance, as well as fails to meet the Corps own objectives for compensatory mitigation.***

The Corps has proposed reforesting (or allowing to revegetate) 9,423 acres of frequently flooded lands in or possibly adjacent to the project area to compensate for habitat losses in both basins.

Although the Corps recognizes the importance of mitigation in the area of project impacts, we have noted previously that there will not be suitable habitat under post-project conditions to reestablish the required forested wetlands within the basins. In addition, the Corps has noted to the Service that restoration of significant acreage of lands within the proposed project area could greatly reduce the economic benefits of the project, although this is not addressed in the economic analyses in the DEIS.

Another important factor in the feasibility of implementing the recommended mitigation measures is Corps policy that relies on purchasing mitigation lands from willing sellers. Considering the strong local support for the project and recent increases in commodity prices, finding enough interested willing sellers with suitable lands is extremely unlikely. Furthermore, while it is also Corps policy to compensate project impacts concurrently with project construction, reliance on willing sellers places significant constraints on both the timing of land acquisition as well as the location of those acquired lands. The mitigation acreage necessary for each species group is based on those acres *in place and functioning* when project construction is complete. In addition, for lands to offset both wetland and fisheries impacts, they must have significant inundation and fisheries acres in the spring while also able to support viable bottomland hardwood forest species. Acres that mitigate waterfowl impacts must be flooded no more than 24 inches to be accessible to most dabbling and diving ducks in the project area. Given the hydrology and large acreage necessary to compensate project impacts, acquiring suitable land from willing sellers in a timely manner would seem to present a great challenge to the Corps and the local sponsors.

Because the location of potential mitigation sites is unknown, it is impossible to validate the numerous assumptions used in modeling compensatory mitigation acreage. Those assumptions can significantly influence the modeled benefits of a tract and thus greatly change both the acreage as well as the costs of adequately implementing compensatory mitigation. Without far more detailed information on the mitigation sites, there is no assurance what portion of project losses would be offset. The mitigation plan should also identify the parties responsible for ownership and all long-term management of the compensatory mitigation. In addition, the AM plan for the mitigation portfolio should be far more developed, with specific monitoring parameters, decision points, operational triggers, and alternative operations clearly identified. The long-term management plan should also include a description of long-term management needs, annual cost estimates for these needs, and identify the funding mechanism that will be used to meet those needs. The Corps as well as the Service is increasingly aware of the time, effort and cost it takes to develop a fully functioning adaptive management plan for a project of this size. The details should not be left to an unspecified group at an unspecified time in the future. MDC and MDNR will be critical partners in developing and adequate AM program. We recommend that the Corps refer the mitigation bank guidelines as an example of the level of detail necessary to address specific mitigation designs, conduct compliance reviews, consult and approve adaptive management plans and ensure corrective measures are implemented if needed.

The Service supports the Corps policy of mitigation acquisition during project construction because it is critical to adequately compensate project-related impacts to fish and wildlife. However, we also recognize that circumstances beyond the Corps control may significantly delay or otherwise impede timely implementation of the mitigation plan. That could result in significant unmitigated adverse impacts to fish and wildlife resources. Therefore, to ensure that fish and wildlife resources are conserved, we recommend that the Corps not construct closure of the 1500-foot gap in the mainline levee of the New Madrid Floodway and not operate either of the pump stations until mitigation for that project feature is in place. The Corps should include that condition as part of the operation plans for both pumping stations. To provide some flexibility, if a significant portion of the mitigation for the pump stations is in place by the time project construction is complete, the Service offers to work with the Corps to develop an alternative pump operation plan that would ensure those operations result in impacts no greater than what has been mitigated for at that time. The Service recommends that such operation guidelines become an integral part of the either alternative. We believe adherence to those guidelines is the only way to ensure that fish and wildlife resources receive equal consideration with other project purposes.

Summary and Recommendations

The project purpose is to provide an unspecified amount of flood risk reduction to the proposed project area. As currently proposed, the overwhelming majority of project benefits are related to agricultural intensifications and flood protection. It is impossible to determine the meta data used for the Corps cost:benefit analysis in the DEIS, which appears to be driving the decision to proceed with a project. For example, when calculating “benefit” values associated with agricultural, only the net increase in commodity value resulting from a project should be used (not total agricultural income). Agricultural production has occurred in the area for decades and will continue to occur without the project, so it is the **net-added** benefit of various proposal alternatives that must be carefully determined and used in the calculation. Moreover, there is no accounting for losses in ecological goods and services provided by existing wetlands; values that would be reduced or eliminated by conversion wetlands to agriculture lands. Outcome of the Corps’ cost:benefit analysis drives project decisions, thus using an inflated benefit or deflated cost estimate elevates a proposal score, giving it a Corps “justifiable” rating. The cost:benefit calculation must be complete from an environmental and various social perspectives, especially considering the irreversible intent of land conversion behind the proposed barriers between the river and floodplain.

The TSP will eliminate spring overbank flooding that currently may cover tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by the TSP. Seasonal backwater flooding in the New Madrid Floodway provides important floodplain habitat that supports an extremely abundant and diverse fish fauna (both floodplain and riverine), some of which are becoming regionally scarce. The interchange between the Floodway and the river supports a sustainable ecosystem not found elsewhere along the Mississippi River in Missouri. Alterations in the extent and timing of seasonal flooding in the project area greatly concern the Service not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

The Corps has proposed reforesting 9,423 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate losses of wetland habitat value, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, and water quality changes. Fish and wildlife species with limited mobility (i.e., reptiles, amphibians, and larval fishes) will experience a net loss of habitat within the project area that may not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Because the project will negatively affect nationally significant fish and wildlife resources in the project area, the Service recommends that the Corps implement the following measures to ensure that fish and wildlife receive equal consideration with other project purposes:

1.) Construct a St. Johns Bayou Basin only alternative that will avoid significant losses of fish and wildlife habitat and functions, while providing flood risk reduction focused on urban and residential areas, as well as public infrastructure.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:

    a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

    b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

    c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

    d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. They may also function as grade control structures.

    e.) Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

    f.) Avoiding dredging in a 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements, etc.) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the TSP, they should incorporate the following measures as integral features of the selected plan:

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 291 and 290.4 feet NGVD in the St. Johns basin, and between 292.1or 287.6 feet NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures:

- Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). If protective covenants have not been placed on bottomland hardwood forest as described in 4(b), the Corps should reforest an additional acres to compensate for induced forested wetland losses because project-related reductions in flooding.

- Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

- Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below).

- To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest additional acres of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

- Provide shallow flooded (i.e., # 18 inches) land during spring and fall migration to compensate for project-related losses in shorebird migration habitat. Constructing moist soil areas to mitigate those losses would reduce the necessary acreage compare to cropland.

- Use both the Missouri Stream Mitigation Method and the Missouri Wetlands Assessment Method to assess project impacts and compensatory mitigation for wetlands and streams and conduct a review that includes the Interagency Review Team.
- Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with most project construction activities, except for constructing the New Madrid Floodway Levee closure, and should be in place prior to project operation. Closure of the 1,500-foot levee gap should not be constructed until all mitigation measures are in place and functioning as planned.
- Provide a detailed adaptive management program to manage all compensatory mitigation features as well as modifications to proposed project operations to fully offset losses of fish and wildlife resources.
- Do not include existing conservation lands (e.g., Ten Mile Pond Conservation Area) lands as part of compensatory mitigation for this project.

Should the Corps pursue a Floodway closure alternative, we recommend alternative 4.1 which would have the fewest effects to fish and wildlife with minimal changes to project benefits, and a higher cost:benefit ratio than the preferred alternative.

Service Position

The Service and the Corps have strived to develop measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate cover types (i.e., bottomland hardwood forest, moist soil, borrow pits), only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, habitat functions must also be maintained. While the proposed mitigation plan would potentially compensate fish and wildlife habitat losses that can be quantified with current models for estimating wildlife effects of water development projects, it would not sustain all the important ecological functions of the floodplain-river ecosystem in the project area.

The Service opposes the St. Johns Bayou and New Madrid Floodway preferred alternative because:

1.) As proposed, the preferred alternative would cause substantial, irretrievable losses of nationally significant fish and wildlife resources, and greatly diminish rare and unique habitats found in southeast Missouri.

4.) We believe project-related wetlands losses are at odds with the Administration's conservation policy goals and those of the Clean Water Action Plan.

5.) The St. Johns Basin only alternative (Alternative 2.1) is a technically and economically feasible alternative that would meet the project purpose while avoiding losses to nationally significant fish and wildlife resources.

If the Corps proceeds with project construction, at a minimum, they should include the Service's above-mentioned recommendations as integral components of the project.

LITERATURE CITED

Aggus, L.R. and G.R. Ploskey. 1986. Environmental design considerations for main stem borrow areas along the lower Mississippi River. U.S. Army Corps of Engineers, Lower Mississippi River Environmental Program, Report 4, Vicksburg, Mississippi.

Ahlstedt, S.A. and J.J. Jenkinson. 1993-1994. A search for additional populations of *Potamilus capax* in the St. Francis and Cache River Watersheds, Arkansas and Missouri, U.S.A. *Walkerana* 7(17/18): 71-157.

Ahlstedt, S.A. and J.J. Jenkinson. 1991. Distribution and abundance of *Potamilus capax* and other freshwater mussels in the St. Francis River System, Arkansas and Missouri, U.S.A. *Walkerana*, 5(14):225-261.

Ahlstedt, S.A. and J.J. Jenkinson. 1987. Distribution and abundance of *Potamilus capax* and other freshwater mussels in the St. Francis River system, Arkansas and Missouri. Tennessee Valley Authority. Knoxville, Tennessee. 43 pp. + Appendices.

Amoros, C. 1991. Changes in side-arm connectivity and implications for river system management. *Rivers* 2(2):105-112.

Anteau, M.J. and A.D. Afton. 2009. Wetland use and feeding by lesser scaup during spring migration across the upper Midwest, USA. *Wetlands* 29:704–712.

Askins, R.A., J.F. Lynch and R. Greenberg. 1990. Population declines in migratory birds in eastern North America. *Current Ornithology* 7:1-57.

Baker, J.A., K.J. Killgore, and R.L Kasul. 1991. Aquatic habitats and fish Communities in the Lower Mississippi River. *Aquatic Sciences* 3(4):313-356.

Barnhart, M.C., A.D. Roberts, and F. Riusech. 1996. Reproductive biology and ecology of the flat floater mussel, *Anodonta suborbiculata*, Say in Kansas. Project report, Kansas Department of Wildlife and Parks. 52 pp.

Barnhart, M.C. 1998. A survey of unionid mussels in the St. John's Basin and the New Madrid Floodway. A report submitted to the Memphis Corps of Engineers.

Barnickol, P. and W. Starrett. 1951. Commercial and sport fishes of the Mississippi River between Caruthersville, Missouri and Dubuque, Iowa. *Bulletin of the Illinois Natural History Survey* 25:267-350.

Beland, R. 1953. The effect of channelization on the fishery of the lower Colorado River. *California Fish and Game.* 39:137-139.

Bellrose, F. C. 1980. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pennsylvania, USA.

Bellrose, F.C. and R.D. Crompton. 1970. Migrational behavior of mallards and black ducks as determined from banding. *Illinois Natural History Survey Bulletin* 30:167-234.

Benke, A.C., R.L. Henry, III, D.M. Gillespie, and R.J. Hunter. 1985. Importance of snag habitat for animal production in southeastern streams. Fisheries Vol. 10, No. 5.

Brinson, M.M., B.L. Swift, R.C. Plantico and J.S. Barclay. 1981. Riparian Ecosystems: their ecology and status. Fish and Wildlife Ecological Service Biological Report FWS/OBS-81/71. 154 pp.

Bryan, C.F. and D.S. Sabins. 1979. Management implications in water quality and fish standing stock information in the Atchafalaya Basin, Louisiana. Pages 293-316. *In,* J.W. Day, Jr. and R.H. Chabreck (eds.), Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University, Department of Continuing Education, Baton Rouge.

Carter, R. And C.T. Bryson. 1991. A report of *Cyperus grayoides* and *C. retroflexus* (CYPERACEAE) new to Missouri, and notes on other selected Missouri *Cyperus*. *Sida* 14(3):475-481.

Cobb, S.P. and J. Kaufman. 1993. Clearing and snagging. Pages 169-180. *In* C.F. Bryan and D.A. Rutherford (eds). Impacts on warmwater streams: guidelines for evaluation. Southern Division, American Fisheries Society, Little Rock, AR.

Constants, G.C., W.W. Kelso, D.A. Rutherford, and C.F Bryan. 1997. Habitat, Movement and Reproductive Status of Pallid Sturgeon *(Scaphirhynchus albus*) in the Mississippi and Atchafalaya rivers. US Army Corps of Engineers, New Orleans District. 64 pp.+ appendices.

Cummings, K.S., M.E. Retzer, C.A. Mayer and L.M. Page. 1990. Life history aspects and status of the Federally endangered fat pocketbook, *Potamilus capax* (Green 1832) (Mollusca:Unionidae), in the Lower Wabash River, Illinois and Indiana. Technical Report 1990 (1). Illinois Natural History Survey. Champaign, Illinois. 37 pp.

Cummings, K.W., R.C. Peterson, F.O. Howard, J.C. Wycheck and V.I. Holt. 1973 The utilization of leaf litter by stream detritivores. *Ecology* 54:336-345.

Dutterer, A.C., C. Mesing, R. Cailteux, M.S. Allen, W.E. Pine and P.A. Strickland. 2012. Fish recuitment is influenced by river flows and floodplain inumdation at Apalachicola River, Flordia. River Research and Applications DOI: 10.1002/rra.2604.

Ebert, D.J. 1993. Dredging. 157-167 pp. *In* C.F. Bryan and D.A. Rutherford (eds), Impacts on warmwater streams: guidelines for evaluation. Southern Division, American Fisheries Society, Little Rock, AR.

Eckblad, J.W., C.S. Volden and L.S. Weilgart. 1984. Allochthonous drift from backwaters to the main channel for the Mississippi River. *Canadian Journal of Zoology* 66:352-363.

Environmental Science and Engineering, Inc. 1978. Inventory of water quality and aquatic biology, Mississippi County Spillway Watershed and Peafield drainage. Final Report, Contract No. AG29SCS-00638. 179 pp.

Fredrickson, L.H. and D.L. Batema. 1992. Greentree Reservoir Management Handbook. Gaylord Memorial Laboratory, Wetlands Management Series, Number 1. 79 pp.

Fredrickson and Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323. *In*, M.W. Weller (ed.), Waterfowl in Winter - a symposium. Univ. Minnesota Press, Minneapolis, MN.

Fremling, C.R., J.L. Rasmussen, R.E. Sparks, S.P. Cobb, C.F. Bryan and T.C. Claflin. 1989. Mississippi River fisheries: a case history. Pages 309-351. *In*, D.P. Dodge (ed.), Proceedings of the International Large River Symposium. Can. Spec. Publi. Fish. Aquat. Sci. 106.

Fuller, S.L.H. 1974. Clams and mussels (Mollusca: Bivalvia). Pages 215-273. *In*, C.W. Hart, Jr. and S.L.H. Fuller (eds.), Pollution ecology of freshwater invertebrates. Academic Press, New York.

Galat, D.L., L.H. Fredrickson, D.D. Humburg, K.J. Bataille, J.R. Bodie,J.D. Dohrenwend, G.T. Gelwicks, J.E. Havel, D.L. Helmers, J.B. Hooker, J.R. Jones, M.F. Knowlton, J. Kubisiak, J. Mazourek, A.C. McColpin, R.B. Renken and R.D. Semlitch. 1998. Flooding to restore connectivity of regulated, large-river wetlands. *BioScience Vol. 48 No. 9: 721-733.*

Gallagher, R.P. 1979. Local distribution of icthyoplankton in the lower Mississippi River, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 52 pp.

Gerrity, P.C., C.S. Guy and W.M. Gardner. 2006. Juvenile pallid sturgeon are piscivorous: a call for conserving native cyprinids. Transactions of the American Fisheries Society 135:604-609.

Gore, J.A. and F.D. Shields, Jr. 1995. Can large rivers be restored? *BioScience* (45)3:142-152.

Guillory, V. 1979. Utilization of an inundated fIoodplain by Mississippi River fishes. *Florida Scientist*, 42(4):222-228.

Hall, H.D. and V.W. Lambou. 1990. The ecological significance to fisheries of bottomland hardwood systems: values, detrimental impacts, and assessment: the report of the fisheries workgroup. *In* J.G. Gosselink, L.C. Lee, and T.A. Muir (eds.), Ecological processes and cumulative impacts. pp. 481-531. Lewis Publishers Inc.

Hansen, D.R. 1971. Stream channelization effects on fishes and bottom fauna in the Little Sioux River, Iowa, 29-15 pp. *In* E.Schenberger and J.L. Funk (eds.), Stream channelization: a symposium. Special Publication No. 2, North Central Division, American Fisheries, Society, Omaha, Nebraska.

Hartfield, P. 1993. Headcuts and their effect on freshwater mussels. Pages 131-141. *In* K.S. Cummings, A.C. Buchanan, and L.M. Koch, (eds.), Conservation and management of freshwater mussels. Proceedings of a UMRCC symposium, 12-14 October 1992, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Heimlich, R.E., K.D. Wiebe, R. Claassen, D. Gadsby and R.M. House. 1998. Wetlands and Agriculture: Private Interests and Public Benefits. U.S. Department of Agriculture, Agricultural Economic Report No. 765. Resource Economics Division, Economic Research Service, Washington, D.C. 94 pp.

Heitmeyer, M.E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the upper Mississippi Delta. Ph.D. Thesis, Univ. Missouri, Columbia. 376 pp.

Helmers, D.L. 1992. Shorebird management manual. Western Hemisphere Shorebird Reserve Network, Manomet, MA. 58 pp.

Hoggarth, Michael A. 1992. An examination of the glochidia-host relationships reported in the literature for North American Species of Unionacea (Mollusca:Bivalvia). Malacology Data Net. Vol. 3. Nos. 1-4. 1-30.

Hoover, J.J. and K.J. Killgore. 1996. Impacts of Mississippi Delta flood control project on fish habitat. Appendix to EIS, Mississippi River and Tributaries Project, Mississippi Delta Project. U.S. Army Engineer District, Vicksburg.

Hoover, J.J. and K.J. Killgore. 1998. Fish Communities. Pages 237-260. *In*, M.G. Messina and W.H. Conner (eds.), Southern forested wetlands ecology and management, Lewis Publishers, New York.

Hove, M.C. 1995. Suitable hosts of the lilliput, *Toxolasma parvus*. Triannual Unionid Report 8:9. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Hove, M.C., R.A. Engelking, M.E. Peteler, and E.M. Peterson. 1995. *Anodontoides ferussacianus* and *anodonta imbecillis* host suitability tests. Triannual Unionid Report 6:22. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Hove, M.C., R.A. Engelking, M.E. Peteler, and L. Sovell. 1994. Life history research on *Ligumia recta* and *Lasmigona costata*. Triannual Unionid Report 4:23. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Hrabik, R.A. 1994. A synopsis of the effects of the 1993 flood on the biota of the open Mississippi River near Cape Girardeau.

Janáč, M. P. Jurajda, Z. Valova and M. Reichard. 2010. Flood duration determines the reproduction success of fishes in artificial oxbows in a floodplain of a potomal river. Ecology of Freshwater Fish 19:644-655.

Jenkinson, J.J. and S.A. Ahlstedt. 1993-1994. A search for additional populations of *Potamilus capax* in the St. Francis and Cache River watersheds, Arkansas and Missouri, U.S.A. *Walkerana* 7(17/18): 71-157.

Jenkinson, J.J. and S.A. Ahlstedt. 1987. A search for additional populatons of *Potamilus capax* in the St. Francis and Cache River watersheds, Arkansas and Missouri. Final Report. Tennessee Valley Authority, Office of Natural Resources and Economic Development, Knoxville, Tennessee 37902. Prepared for the Memphis District, U.S. Army Corps of Engineers. 104 pp. w/appendices.

Johnson, T.R. 1997. The amphibians and reptiles of Missouri. Missouri Department of Conservation, Jefferson City. 369 pp.

Jones, K. H. 2012. Population survey of the Interior least tern on the Mississippi River from Cape Girardeau, Missouri to Baton Rouge, Louisiana, 2012. Dyersburg State Community College, Dyersburg, Tennessee. Report prepared for the U.S. Army Corps of Engineers, Memphis District, Memphis, Tennessee.

Jones, K.H. 1997. Population survey of the interior least tern on the Mississippi River from Cape Girardeau to Vicksburg, Mississippi. Prepared for the U.S. Army Corps of Engineers, Memphis District. 15 pp.+appendix.

Junk, W.J., P.B. Bayley and R.E. Sparks. 1989. The flood pulse concept in river-floodplain systems. 110-127 pp. *In* D.P. Dodge (ed.), Proceedings of the International Large River Symposium. Can. Spec. Publ. Fish. Aquat. Sci. 106.

Karr, J.R., and I.J. Schlosser. 1978. Water resources and the land-water interface. *Science* 201:229-234.

Killgore, K.J. and J.J. Hoover. 1996. Impacts of Yazoo backwater reformulation project on fish habitat. Draft Appendix on EIS, Mississippi River and Tributaries Project, Mississippi Delta Project. U.S. Army Engineer District, Vicksburg.

Killgore, K.J. and J.J. Hoover. 1998. Impacts of St. Johns Bayou-New Madrid Floodway flood control project on fishes. 28 pp.

Korschgen, L.J. and D.L. Moyle. 1955. Food habits of the bullfrog in central Missouri farm ponds. *American Midland Naturalist* 54(2):332-341.

Korschgen, L.J. and D.L. Moyle. 1963. Foods of impoundment-and stream-dwelling bullfrogs in Missouri. *Herpetology* 19(2):89-99.

Kurth, J.E. and M.C. Hove. 1997. Host fish suitability studies and host attracting behaviors of *Tritogonia verrucosa*, the pistolgrip. Triannual Unionid Report 12:10. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Lambou, V.W. 1962. Comments on proposed dam on Old River, Batchelor, La. Louisiana Wildlife and Fisheries Commission. 37 pp.

Lambou, V.W. 1990. Importance of bottomland hardwood forest zones to fishes and fisheries: the Atchafalaya basin, a case history. Pages 125-193. *In*, J.G. Gosselink, L.C. Lee, and T.A. Muir, (eds.), Ecological Processes and Cumulative Impacts: Illustrated by bottomland hardwood wetland ecosystems.

Luo, M. 1994. Host fishes of four species of freshwater mussels, and development of an immune response. Triannual Unionid Report 3:24. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Luckey, R.R. 1985. Water resources of the southeast lowlands, Missouri. Water Investigations Report 84-4277. U.S. Geological Survey, Rolla, Missouri. 78 pp.

Maki, T.E., A.J. Weber, D.W. Hazel, S.C. Hunter, B.T. Hyberg, D.M. Flinchum, J.P. Lollis, J.B. Rognstad and J.D. Gregory. 1980. Effects of stream channelization on bottomland and swamp forest ecosystems. Water Resources Research Institute, University of North Carolina, Raleigh, North Carolina. 135 pp.

Marzolf, G.R. 1978. The potential effects of clearing and snagging on stream ecosystems. U.S. Fish and Wildlife Service, FWS/OBS-78/14, Washington D.C.

MDC. 1989. Missouri Department of Conservation wetlands management plan. Missouri Department of Conservation, Jefferson City, Missouri. 157 pp.

MDC. 1997. Fisheries Research Database, Missouri Department of Conservation, Jefferson City, Missouri.

MDC. 1999. Natural heritage database: Mississippi and New Madrid counties. Missouri Department of Conservation, Jefferson City, Missouri..

MDNR. 1997. Checklist of Plant and Animals of Big Oak Tree State Park. Missouri Department of Natural Resources.

Momot, W.T., H. Gowing, and P.T. Jones. 1978. The dynamics of crayfish and their role in ecosystems. *American Midland Naturalist* 99(1):10-35.

National Research Council. 1992. Restoration of aquatic ecosystems: science, technology, and public policy. National Academy Press, Washington, D.C.. 552 pp.

NAWMP. 2004. North American waterfowl management plan: strengthening the biological foundation (Implementation Framework). U.S. Department of Interior, Fish and Wildlife Service, and Environment Canada, Canadian Wildlife Service.

NAWMP. 2012. North American Waterfowl Management Plan 2012: people conserving waterfowl and wetlands. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Amiente y Recursos Naturales.

Neves, R.J. 1993. A state-of-the-unionids address. Pages 1-10. *In* K.S. Cummings, A.C. Buchanan, and L.M. Kock (eds.), Conservation and management of freshwater mussels.

Nichols, J.D., K.J. Reinecke and J.E. Hines. 1983. Factors affecting the distribution of mallards wintering in the Mississippi Alluvial Valley. *Auk* 100:932-946.

Oesch, R.D. 1995. Missouri naiades. Missouri Department of Conservation, Jefferson City. 271 pp.

Olson, K.R. and L.W. Morton. 2012. The impacts of 2011 induced levee breaches on agricultural lands of Mississippi River valley. *Journal of Soil and Water Conservation 67*(1):5A-10A.

Phelps, Q., S. Tripp, and D. Herzog. 2012. Temporary Connectivity: A Comparison of the New Madrid Floodway and the Main River. Presentation to the American Fisheries Society. Big Rivers and Wetland Field Station, Jackson, Missouri

Pflieger, W.L. 1997. Fishes of Missouri. Missouri Department of Conservation, Jefferson City. 372 pp.

Poff, N.L., J.D. Allen, M.B. Bain, J/R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks and J.C. Stromberg. 1997. The natural flow regime. *BioScience Vol. 47 No. 11:769-784.*

Power, M.E. 1984. Predator avoidance by grazing fishes in temperate tropical streams: importance of stream depth and prey size. Pages 333-351 *in* W.C. Kerfoot and A. Sih, editors. Predation. Direct and indirect effects on aquatic communities. University Press of New England, Hanover, NH.

Reed, B.C. and M.S. Ewing. 1993. Status and distribution of pallid sturgeon at the Old River Control Complex, Louisiana. 54 pp.

Reinecke, K.J., J.D. Moorhead, J.D. Hodges, and J.R. Nasser. 1989. Mississippi Alluvial Valley. Pages 203-247. *In* L.M. Smith, R.L. Pederson, and R.M. Kaminski (eds.), Habitat management for migrating and wintering waterfowl in North America. Texas Tech Univ. Press, Lubbock.

Ridenour, C.J. 2007. Assemblage structure and shallow-water habitat use by small-bodied fishes at lower Missouri River sandbars. Master's Thesis. University of Missouri, Columbia, MO.

Ridenour, C.J., A.B. Starostka, W.J. Doyle and T.D. Hill. 2009. Habitat used by *Macrhybopsis* chubs associated with channel modifying structures in a large regulated river: implications for river modification. River Research and Applications 25:472-485.

Ridenour, C.J., H.A. Meyer, C.J. Wrasse, W.J. Doyle and T.D. Hill. 2012a. 2011 Annual report: Pallid sturgeon population assessment and associated fish community monitoring for the Missouri River: Segment 13. United States Fish and Wildlife Service, Columbia Missouri Fish and Wildlife Conservation Office. 128 pp.

Ridenour, C.J., C.J. Wrasse, H.A. Meyer, W.J. Doyle and T.D. Hill. 2012b. Variation in fish assemblages among four habitat complexes during a summer flood: implications for flow refuge. Pallid sturgeon population assessment and associated fish community monitoring for the Missouri River 2011 contingency sampling. United States Fish and Wildlife Service, Columbia Missouri Fish and Wildlife Conservation Office. 39 pp.

Risotto, S.P. and R.E. Turner. 1985. Annual fluctuation in abundance of the commercial fisheries of the Mississippi River and tributaries. *North American Journal of Fisheries Management* 5:557-574.

Robbins, M.B. and D. A. Easterla. 1992. Birds of Missouri: Their Distribution and Abundance. University of Missouri Press. 399 pages.

Robbins, C.S., D.K. Dawson and B.A. Dowell. 1989. Habitat are requirements of breeding forests birds of the Middle Atlantic States. *Wildlife Monographs* 103:1-34.

Roberts, A.D., A.P. Farnsworth and J. Sternburg. 1997. A search for fat pocketbooks, *Potamilus capax*, in southeast Missouri. Internal Report, Missouri Department of Conservation, Natural History Section.

Sabo, M.J. and W.E. Kelso. 1991. Relationship between morphometry of excavated floodplain ponds along the Mississippi River and their use as fish nurseries. Transactions of the American Fisheries Society 120:552-561.

Schlosser, I.J. 1987. The role of predation in age- and size-related habitat use by stream fishes. Ecology 68:651-659.

Sheehan, R., R.C. Heidinger, P.S. Wills, M.N. Alarcon and M.A. Schmidt. 1998. St. Johns basin and New Madrid Floodway fisheries survey: final report. 39 pp.

Soulliere, G.J., B.A. Potter, J.M. Coluccy, R.C. Gatti., C.L. Roy, D.R. Luukkonen, P.W. Brown, and M.W. Eichholz. 2007. Upper Mississippi River and Great Lakes Region Joint Venture

Waterfowl Habitat Conservation Strategy. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota, USA.

Stern, D.H. and M.S. Stern. 1980. Effects of bank stabilization on the physical and chemical characteristics of streams and small rivers: a synthesis. U.S. Fish and Wildlife Service Biological Report, FWS/OBS-80/11. 42 pp.

Stucker, J.H., M. H. Sherfy, and L.L. Strong. 2011. Patterns and Timing of Movement by Least Tern on the Missouri River. Presentation, Missouri River Natural Resources Committee Missouri River Annual meeting, Pierre S.D.

Taylor, J.R., M.A. Cardamone and W.J. Mitsch. 1990. Bottomland hardwood forests: their functions and values. Pages 13-86. *In*, J. Gosselink, L.C. Lee, and T.A. Muir, (eds.), Ecological Processes and Cumulative Impacts: Illustrated by bottomland hardwood wetland ecosystems.

Tibbs, J. E. and D. L. Galat. 1997. Larval, juvenile, and adult small fish use of scour basins connected to the lower Missouri River. Final Report to Missouri Department of Conservation, Columbia, MO. 133 pp.

Turner, T.F., J.C. Trexler, G.L. Miller and K.E. Toyer. 1994. Temporal and spatial dynamics of larval and juvenile fish abundance in a temperate floodplain river. *Copeia* (1):174-183 pp.

U.S. Army Corps of Engineers. 2013. St. Johns Bayou/ New Madrid Floodway Project, Draft Environmental Impact Statement, Revised Advance Copy, June 2013. 368 page + appendices.

U.S. Army Corps of Engineers. 1998. Mississippi River mainline levees enlargement and seepage control, Cape Girardeau, Missouri to Head of Passes, LA, Project Report and Supplemental Environmental Impact Statement, Volume 1. 44 pp. and appendices.

U.S. Army Corps of Engineers. 1997. St. Johns Bayou and New Madrid Floodway Missouri, First Phase, Draft Limited Reevaluation Report.

U.S. Army Corps of Engineers. 1980. St. Johns Bayou and New Madrid Floodway, Missouri. Phase I General Design Memorandum and Environmental Impact Statement, Volume 1. Memphis District, Corps of Engineers, Memphis, Tennessee. 145 pp. + appendices.

U.S. Fish and Wildlife Service. 2013. Draft Biological Opinion for the St. Johns Bayou Basin and New Madrid Floodway project.

U.S. Fish and Wildlife Service. 1989. A recovery plan for the fat pocketbook pearly mussel, *Potamilus capax* (Green 1832). U.S. Fish and Wildlife Service. Atlanta, Georgia. 22 pp.

U.S. Fish and Wildlife Service. 1981. *Federal Register.* Volume 46, No. 15, January 23.

U.S. Fish and Wildlife Service. 1980. Habitat suitability procedures. U.S. Fish and Wildlife Services, Division of Ecological Services, Washington D.C. Ecological Services Manual 102.

U.S.G.S. 1991-1996. Long-term Resources Monitoring Station data base: Open river samples near Cape Girardeau. Environmental Management Technical Center http:\\www.emtc.nbs.gov\.

Watters, T.G. 1994. An annotated bibliography of the reproduction and propagation of the Unionoidia (Primarily in North America). Ohio Biological Survey Miscellaneous Contributions No. 1. 158 pp.

Watters, G.T. 1996. New hosts for *Lampsilis cardium*. Triannual Unionid Report 9:8. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Watters, G.T. and S.H. O'Dee. 1997a. Identification of potential host: *Elliptio fisheriana* (Lea 1838), *Fusconaia masoni* (Conrad 1834), *Fusconaia flava* (Rafinesque 1820), and *Pleurobema clava* (Lamark 1819). Triannual Unionid Report 12:38. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Watters, G.T. and S.H. O'Dee. 1997b. Potential hosts for *Lampsilis radiata luteola* (Lamark, 1819). Triannual Unionid Report 12:6. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Weiss, J.L. and J.B. Layzer. 1995. Infestations of glochidia on fishes in the Barren River, Kentucky. *American Malacological Bulletin* 11(2):153-159.

Welcomme, R.L. 1979. Fisheries ecology of floodplain rivers. Longman, Inc., New York. 317 pp.

Wharton, C.H., W.M. Kitchens and T.W. Sipe. 1982. The ecology of bottomland hardwood swamps of the southeast: a community profile. Fish and Wildlife Ecological Services Biological Report FWS/OBS-81/37. 133 pp.

Whitledge, G. W., D. L. Galat, and G. T. Gelwicks. 2005. Habitat use by fishes in periodically and continuously connected lower Missouri River floodplain water bodies. Final Report to Missouri Department of Conservation, Columbia, MO. 68 pp.

Williams, J.D., M.L. Warren, K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries* 18(9): 6-22.

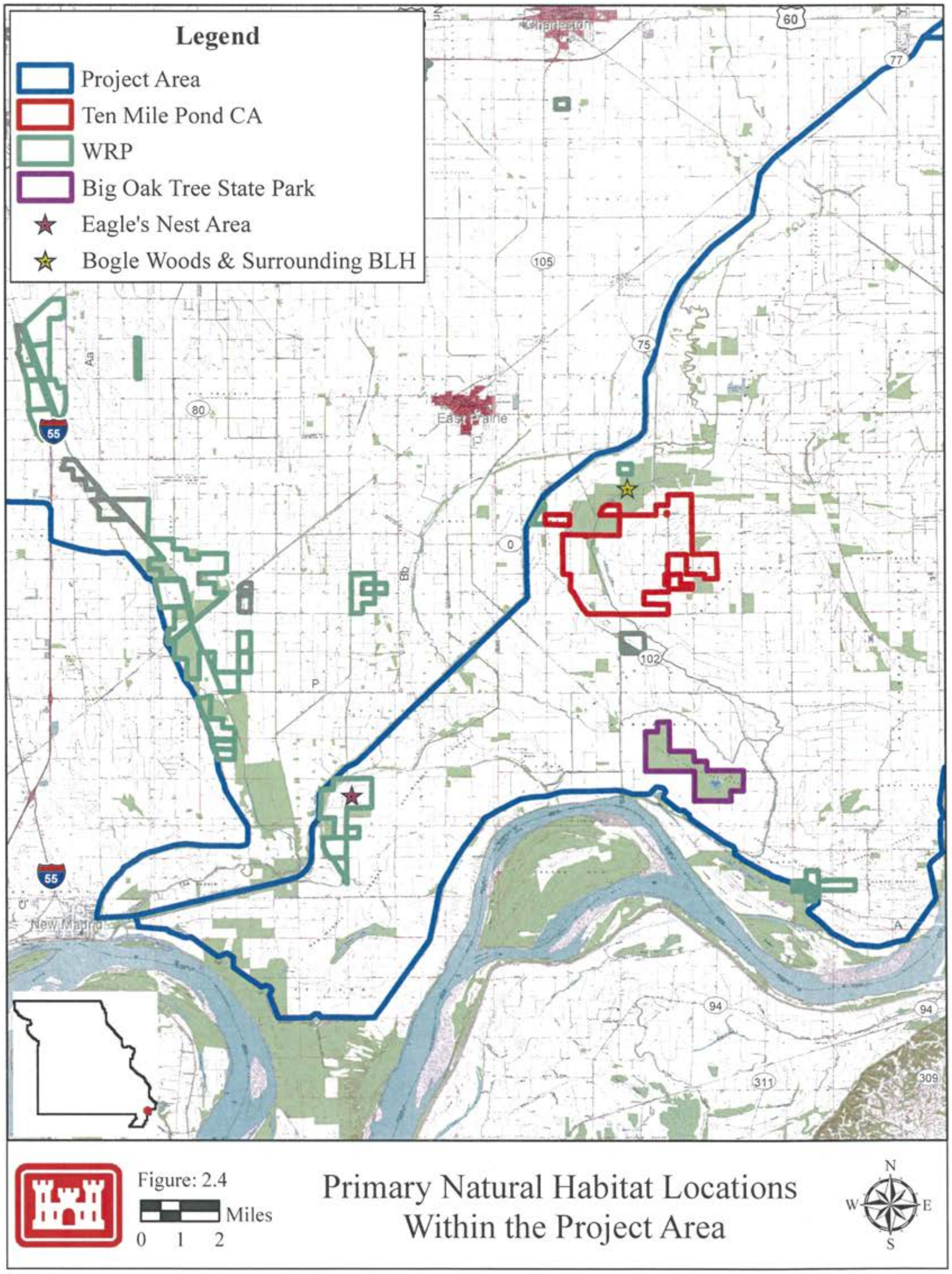


Figure 1. Project area with conservation lands identified

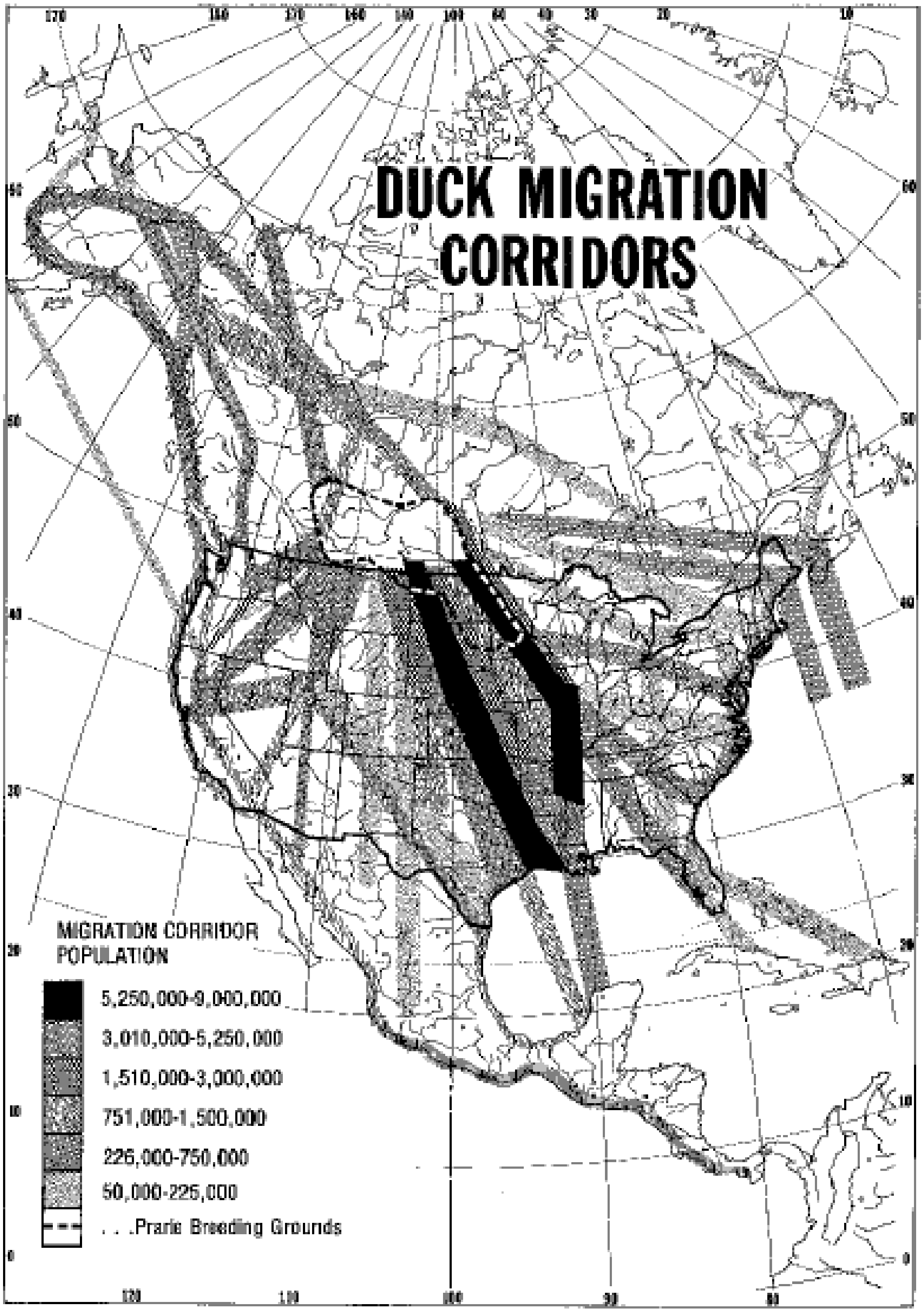


Figure 2. Duck Migration Corridors

Table 1 Wetlands in the St. Johns Bayou and New Madrid Basins

<u>**Wetlands**</u>	<u>**St. Johns Bayou**</u>			<u>**New Madrid Floodway**</u>		
<u>**5-Year Flood Zone**</u>	EPA[1]	Corps[2]	NWI[3]	EPA	Corps	NWI
Naturally vegetated	6352	5767	5749	7631	7884	9664
Wetlands in Ag.	11494	145	15454	29717	175	35049
Total	**17846**	**5912**	**21203**	**37348**	**8059**	**44713**
<u>**Above 5-Year Flood Zone**</u>						
Naturally vegetated	1614	*	577	1402	*	1221
Wetlands in Ag.	9366	*	5224	21024	*	7622
Total	**10980**		**5801**	**22426**		**8843**
<u>**Total wetlands**</u>						
Naturally vegetated	7966	5767	6326	9033	7884	10885
Wetlands in Ag.	20860	145	20678	50741	175	42671
Total	**28826**	5912	**27004**	**59774**	8059	**53556**

---

[1] EPA assessment, March 2012 Draft St. Johns Bayou and New Madrid Floodway Wetlands Assessment

[2] CE PWD EIS October 2011* Corps limited impact analyses to wetlands within the 5 Year Flood zone, although benefits in this zone are counted in the economic analyses

[3] NWI 2011. St. Johns New Madrid Update Summary Draft

Table 2. Species of Conservation Concern in New Madrid and Mississippi counties

Plants	Mississippi	New Madrid
Gourd (*Cayaponia grandifolia*)	S1	
Juniper leaf (*Polypremum procumbens*)	S2	S2
Trepocarpus (*Trepocarpus aethusae*)	S1	S1
Primrose willow (*Ludwigia leptocarpa*)	S2	
Yellow false mallow (*Malvastrum hispidum*)	S3	
Arrow arum (*Peltandra virginica*)	S2	
American frogbit (*Limnobium spongia*)	S2	
American cupsale (*Sacciolepis striata*)	S1	
Swamp loosestrife (*Decondon verticillatus*)	S1	
Bristly sedge *(Carex comosa*)	S2	
Sedge (*Carex socialis*)	S2	
Corydalis (*Corydalis micrantha*)		S2
Leatherflower (*Clematis viorna*)		S1
Finger dog-shade (*Cynosciadium digitatum*)		S2
Weak nettle (*Urtica chamaedryoides*)	S1	S1
Narrow-leaved wild crabapple (*Malus augustifolia*)		S2
Eastern blue-eyed grass (*Sisyrinchium atlanticum*)	S2	S2
An umbrella sedge (*Cyperus retroflexus*)	S1	
An umbrella sedge (*Cyperus grayoidies*)	S3	S3
Many-spiked cyperus (*Cyperus polystachos*)		S2/S3
Baldwin's cyperus (*Cyperus croceus*)		S1
Lake cress (*Rorippa aquatic*)	S2	
Gaping panic grass (*Panicum hians)*	S3	
Horsemint (*Monarda punctate var. villicaulis*)		S3
Saltmarsh aster (*Syphyotrichum subulatum*)		S2
Triangular sedge (*Carex triangularis*)		
Invertebrates		
Rock pocketbook (*Aricidens confragosus*)	S3	S3
Wartyback (*Quadrula nodulata*)	S3	S3
Flat floater (*Anodenta suberbiculata*)	S2	S2
Texas lilliput (*Toxolasma texasensis*)	S3	S3

E - State listed endangered
Rank:
S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).
S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).
S3 - Rare and uncommon in the state (21 to 100 occurrences).
SU - unknown

Table 2 (cont'd.). Species of Conservation Concern in New Madrid and Mississippi counties.

	Mississippi	New Madrid
Invertebrates		
Shufeldt's dwarf crayfish (*Cambarellus shufeldtii)*	S3(?)	
Vernal crayfish (*Procambarus viaeviridis)*	S3(?)	
A mayfly (*Baetisca obesa*)	S3	S3
Bald cypress katydid (*Inscudderia taxodii)*	S1	
Hoosier grasshopper (*Paroxya hoosieri*)	S1	S1
Mammals		
Swamp rabbit (*Sylvilagus aquaticus*)	S2	S2
Cotton mouse (*Peromyscus gossypinus*)		S2
Rafinesque's Big-eared bat (*Corynorhinus rafinequii*)		SU
Southeastern bat (*Myotis austroriparious*)		S1
Birds		
Bald eagle (*Haliaeetus leucocephalus*)	S3	S3
Mississippi kite (*Ictinia mississippiensis*)	S3	S3
Great egret (*Ardea alba)*	S3	
Interior least tern (*Sternula antillarum athalossos)*	(E)S1	(E)S1
Barn owl (*Tyto alba*)	(E)	(E)S3
Swainson's warbler *(Limnothlypis swainsonii)*		(E)S2
Black-crowned night heron (*Nycticorax nyctiocorax*)	S3	
Little blue heron *(Egretta caerulea)*	S3	
Snowy egret *(Egretta thula)*	(E)S1	
Loggerhead shrike (*Lanius ludovicianus)*	S2	
Fish		
Harlequin darter (*Etheostoma histrio*)	(E)S2	S2
Flier (*Centrarchus macropterus*)	S3	S3
Ironcolor shiner (*Notropis chalybaeus*)	S1	S1
Weed Shiner (*Notropis texanus)*	S3	S3

E - State listed endangered
Rank:
S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).
S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).
S3 - Rare and uncommon in the state (21 to 100 occurrences).
SU – unknown

Table 2 (cont'd.). Species of Conservation Concern in New Madrid and Mississippi counties.

Fish	Mississippi	New Madrid
Pallid sturgeon (*Scaphirynchus albus*)	(E)S1	(E)S1
River darter (*Percina shumardi*)	S3	S3
Lake chubsucker (*Erimyzon sucetta*)	S2	S2
Brown bullhead (*Ameiurus nebulosus*)		S3
Mooneye (*Hiodon tergisus*)	R	S2
Golden topminnow (*Fundulus chrysotus*)	S1	
Starhead topminnow (*Fundulus dispar)*	S2	
Sturgeon chub (*Macrhybopis gelida)*	S3	
Flathead chub (*Platygobio gracilis)*	(E)S1	
Western sand darter (*Ammocrypta clara*)		S2S3
Scaly Sand darter (*Ammocrypta vivax)*		S3
Taillight shiner (*Notropis maculaus)*		(E)S1
Central mudminnow (*Umbra limi*)		(E)S1
Pugnose minnow (*Opsopoeodus emiliea)*	S4	S4
Mississippi silvery minnow (*Hybognathus nuchalis*)	S3/S4	
Plains minnow (*Hybognathus placitus)*	S2	
Cypress minnow (*Hybognathus hayi)*		(E)S1
Mississippi silvery minnow (*Hybognathus nuchalis*)		S3S4
Reptiles and Amphibians		
Illinois chorus frog (*Pseudacris streckeri illinoensis*)	S2	S2
Western chicken turtle (*Deirochelys recticularia miaria*)	(E)S1	
Eastern spadefoot *(Scaphiopus holbrookii*)	S2	S2
Alligator snapping turtle (*Macroclemys temminckii*)	S2	S2
Western mudsnake *(Farancia abacura reinwardtii)*	S2	S2

E - State listed endangered
Rank:
S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).
S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).
S3 - Rare and uncommon in the state (21 to 100 occurrences).
SU - unknown

Source: MDC (2013), Carter and Bryson (1991), Barnhart (1998), MDNR (1997)

Appendix A. National Wetlands Inventory Update

National Wetland Inventory Update Draft and Summary Statistics for New Madrid Floodplain and Saint John's Basin Area

Project Title:

New Madrid Floodway National Wetland Inventory (NWI) Update

- **Project Number:** 2219

Cooperator:

GeoSpatial Services of Saint Mary's University of Minnesota

- **Project Manager:** Andrew Robertson
  - email: aroberts@smumn.edu
- **Wetland Scientist:** John Anderson
  - email: janders@smumn.edu
- **QAQC Specialist:** David Rokus
  - email: ddroku04@smumn.edu

United States Army Corps of Engineers

United States Department of Agriculture

United States Environmental Protection Agency

Project Area:

- **Area:** 270,000 acres, or approximately eight, 24K quadrangles of the New Madrid Floodplain (NMF) and Saint John's Basin (SJB).
- **Location:** Eastern portions of Mississippi and New Madrid Counties in Southeast Missouri.
- **Map:**
  - See attached graphic below
- **Collateral Data:**
  - 2009, color-infrared, NAIP image, in Mr. SID format from U.S. Department of Agriculture.
  - Hydric soils in shapefile format from SSURGO.
  - Digital elevation models (DEM) from the United States Geological Survey (USGS) packaged into a seamless internet map display by ESRI.
  - One-foot contours in shapefile format from the Army Corps Of Engineers.
- **Deliverables:**
  - One file geodatabase containing NWI polygons and the NMF and SJB study area boundary.
  - One file geodatabase containing restorable wetland polygons and the NMF and SJB study area boundary.

GeoSpatial Services • Saint Mary's University of Minnesota
700 Terrace Heights • Winona, MN 55987 USA • Office: 507-457-8746 • Fax: 507-457-6604 • www.geospatialservices.org

- Six file geodatabases containing wetland and restorable wetland polygons intersected and parsed by class and water regime to the five-year, ten-year, and beyond the ten-year floodplain, for both the NMF and SJB.
- One Excel spreadsheet summarizing the acreage of NWI and restorable wetland polygons within the five-year, ten-year, or beyond the ten-year floodplain for both NMF and SJB.

- **Status:**
Wetland data update draft and summary statistics have been finalized and submitted for review.

Purpose:

The U.S. Fish and Wildlife Service (USFWS) is the principal federal agency that provides information to the public on the extent and status of the nation's wetlands using mapping and sampling techniques. The agency has developed a series of topical maps to show wetlands and deepwater habitats. This geospatial information is used by federal, state, and local agencies, academic institutions, private industry, tribes, and citizens; for management, research, policy development, education, and planning activities.

Wetlands provide a multitude of ecological, economic, and social benefits. They provide habitat for fish, wildlife, and a variety of plants. Wetlands are nurseries for many saltwater and freshwater fishes and shellfish of commercial and recreational importance. Wetlands are also important landscape features that hold and slowly release flood water and snow melt, recharge groundwater, act as filters to cleanse water of impurities, recycle nutrients, store carbon, and provide recreation and wildlife viewing opportunities for millions of people.

Project Tasks:

1. Administration:

   This task includes overall project management activities such as: assigning duties and responsibilities; tracking project progress; reconciling project expenses; submitting reimbursement requests; processing contract amendments; tracking match contributions; and preparing budget information for reports.

   Responsible Staff: Andrew Robertson

2. Preliminary Meeting and Image Acquisition:
   Discussions items will include:

   - Identification of primary and secondary image sources for wetland mapping.
   - Review of collateral datasets that will be used to support wetland mapping.
   - Confirmation of classification systems including valid Cowardin codes and potential subclasses and special modifiers.

It is anticipated that this initial meeting will be conducted remotely using the GSS license of Go-To-Meeting and the GSS FTP site for data and file transfers. GSS will be represented by Andrew Robertson and John Anderson, Senior Wetland Photo Interpreter and Certified Wetland Scientist.

Responsible Staff: Andrew Robertson, John Anderson

3. Quality Assurance Project Plan Development:

Quality control is a critical component of this wetland mapping project. As an initial step, GSS will use the USFWS NWI ArcGIS master geodatabase verification tool version in ESRI, ArcGIS 10.0 Tool Box for data validation. Secondarily, GSS will develop and apply customized quality control assessment scripts in ArcGIS in order to check for and resolve data integrity issues (e.g. topology, gaps, overlaps, ghosts and adjacent attributes).

These automated tools will complement a rigorous visual quality control process undertaken by a second professional wetland photo interpreter. The purpose of this visual check is to assess classification and delineation accuracy as well as search for errors of omission and commission. In this process, 100% of the data is reviewed to ensure that the accuracy of the final product meets the specifications of the FGDC National Wetland Mapping Standard.

Responsible Staff: David Rokus

4. Geodatabases Assembly:

GeoSpatial Services will assemble an ArcGIS version 10.0 file geodatabase using a projection in UTM Zone 16 North and referenced to the NAD83 geodetic datum. This geodatabase will contain a project area boundary and NWI polygons layers, and a topology verification rules. GSS will also request a checkout geodatabase from the USFWS NWI National Standards and Support Team in order to flag this area in the national wetlands geodatabase as being checked out for update.

Responsible Staff: David Rokus

5. Pre-Mapping Field Review and Mapping Classification:

GeoSpatial Services will conduct a multiple day pre-mapping field trip. The purpose of this trip is to: orient the project photo interpreters to the study area, correlate typical and atypical image signatures to ground conditions for the full range of wetland types included the project, review classification standards for all systems that will be mapped during the project, and develop a set of project photo interpretation conventions to ensure consistent mapping and classification throughout the project. The conventions document will correlate photosignature "keys" (colors, tones, size, shapes, patterns, textures, associations, and shadows) with associated ground features and will form the primary reference for project photo interpreters. Finally, an NWI Field Data Sheet will be prepared for each site documenting presence or absence of hydric soils, hydrophytic vegetation, and wetland hydrology.

Equipment that will be provided by GeoSpatial Services in support of the field review includes: two Garmin Colorado 550t GPS receivers; soil spade, soil probe, Munsell Color charts; interpretive field guides including the National List of Vascular Plants that Occur in Wetlands, sample collection bags, and a digital camera. Prior to embarking on any field site visits, land owner approval will be obtained for sample locations which require access to private land.

Field Trip Dates: July 18 – July 22, 2011
Responsible Staff: John Anderson, David Rokus

6. Mapping and Wetlands Interpretation:

GeoSpatial Services has developed a wetlands mapping workflow process that is based on a combination of fully digital mapping supported by field investigation to interpret and refine wetland boundaries, classification types and functional characteristics. GSS will implement the following technical approach for this project:

i. Perform on-screen delineations of wetlands for each of the +/- eight, USGS 7.5 minute quadrangles included in the project using heads-up digitizing and editing tools in ArcMap with the primary digital imagery and other collateral data as a backdrop. For quadrangles along the State of Missouri, NWI mapping will only be completed for the portion of the quadrangle within the project study area.
ii. All wetland polygons will be classified using the "Classification of Wetlands and Deepwater Habitats of the United States", i.e. Cowardin classification standards.
iii. Undertake quality assurance and quality control reviews as wetland delineation for each 7.5 minute quadrangle is completed. Reviews will consist of a complete visual inspection by a wetland photo interpreter to assess delineation and classification accuracy, check for errors of omission and commission, identify revisions that are necessary to meet the FDGC Federal Wetlands Mapping Standard, and validate the quality of digitized line work. In addition, each quadrangle will be reviewed using internally developed error-checking scripts that search for gaps between adjacent polygons, and adjacent (joined) polygons that contain the same attributes.
iv. Progressively complete edge matching and topological structuring of adjacent 7.5 minute quadrangles. Once all of the quadrangles have been completed, then the entire dataset will be merged to form a seamless file geodatabase for final delivery. The USGS NWI verification tool and other topology validation scripts will be run on the final merged data to ensure data integrity following final processing.
v. Progressively submit the draft of wetland updates to NWI Region 3 coordinator for review and correct any deficiencies that are identified.
vi. Develop full project metadata for the final, seamless wetlands geodatabase. This metadata will meet the requirements of USFWS NWI metadata and will be formatted according to FGDC Metadata Guidelines.

The target mapping unit for this project is the capture of all wetlands greater than one-half acre in size. On-screen wetland delineation will occur at a zoom scale of 1:5,000 and wetland/upland boundary determination will use a maximum zoom scale of 1:3,500. All wetland delineation and classification will be consistent with the primary imagery used for the project and final mapping products will meet the FGDC Federal Wetlands Mapping Standard.

Responsible Staff: John Anderson, David Rokus, Andrew Robertson

7. NWI and Restorable Wetland Statistics Generation:

i. Establish a working directory and file geodatabase titled Contours, for data extraction and analysis. Import NWI polygons, restorable wetlands, and project area boundary features from finalized NWI file geodatabase. Import shapefiles SJB 296 foot, SJB 300 foot, NMF 297 foot, and NMF 305 foot contours to working geodatabase. These elevations represent the five-year, the ten-year, and outside the ten-year flood zones respectively.

ii. Add a field titled "Elevation" to each of the four contour sets and populate accordingly: NMF_297, NMF_305, SJB_296, and SJB_300. The fifth polygon should have an attribute of NoData.

iii. Perform a union between NMF_305 and the project study area and title the feature data class Flood_Zones. Append the remaining three contour sets, NMF_297, SJB_296, and SJB_300 to the Flood_Zones features to create one feature class with two flood zones per basin.

iv. Select polygons NMF_297, merge and clip. Select polygons SJB_296, merge and clip. Select polygons NMF_305, merge and clip. Select polygons SJB_300, merge, clip, and save edits. Below the five-year and below the ten-year flood zone for NMF and SJB is established.

v. To create the division between the NMF and SJB above the ten-year flood zone an editing process needs to take place in ArcMap. Cut the NoData polygon in the southwest portion where the SJB_296 and NMF_297 lobes nearly meet. Using the ESRI seamless topography map as a guide, cut the NoData polygon along the SJB Levee and save edits. The portion to the West of the levee is attributed SJB_301 and the portion to the East is attributed NMF_306. The remaining polygon which includes the Mississippi River and the portion to the west of elevation contours remains NoData.

vi. Export the polygon attributed SJB_296 to a feature data class titled SJB_296_Below. This feature represents the five-year flood zone within SJB. Export the polygon attributed SJB_300 to a feature data class titled SJB_300_Below. This feature represents the ten-year flood zone within SJB. Export the polygon attributed SJB_301 to a feature data class titled SJB_300_Above. This feature represents the area outside the ten-year flood zone within SJB. Export the polygon attributed NMF_297 to a feature data class titled NMF_297_Below. This feature represents the five-year flood zone within NMF. Export the polygon attributed NMF_305to a feature data class titled NMF_305_Below. This feature represents the ten-year flood zone within NMF. Export the polygon attributed NMF_306 to a feature data class titled NMF_305_Above. This feature represents the area outside the ten-year flood zone within NMF.

vii. Intersect NMF_297_Below with NWI_polygons and title NMF_Wetlands_297_Below, (wetlands within the five-year flood zone of the NMF). Intersect NMF _305_Below with NWI_polygons and title NMF_ Wetlands_305_Below, (wetlands within the ten-year flood zone of the NMF). Intersect NMF_305_Above with NWI_polygons and title NMF_Wetlands_305_Above, (wetlands beyond the ten-year flood zone of the NMF). Intersect SJB_296_Below with NWI_polygons and title SJB_ Wetlands_296_Below, (wetlands within the five-year flood zone of the SJB). Intersect SJB_300_Below with NWI_polygons and title SJB_ Wetlands_300_Below, (wetlands within the ten-year flood zone of the SJB). Intersect SJB_300_Above with NWI_polygons and title SJB_ Wetlands_300_Above, (wetlands beyond the ten-year flood zone of the SJB).

viii. Intersect SJB_296_Below with Restorable_Wetlands and title SJB_Restorable_297_Below, (restorable wetlands within the five-year flood zone of the SJB). Intersect SJB_300_Below with Restorable_Wetlands and title SJB_Restorable_300_Below, (restorable wetlands within the ten-year flood zone of the SJB). Intersect SJB_300_Above with Restorable_Wetlands and title SJB_ Restorable_300_Above, (restorable wetlands beyond the ten-year flood zone of the SJB). Intersect NMF_297_Below with Restorable_Wetlands and title NMF_ Restorable_297_Below, (restorable wetlands within the five-year flood zone of the NMF). Intersect NMF_300_Below with Restorable_Wetlands and title NMF_ Restorable_300_Below, (restorable wetlands within the ten-year flood zone of the NMF). Intersect NMF_305_Above with Restorable_Wetlands and title NMF_Restorable_305_Above, (restorable wetlands beyond the ten-year flood zone of the NMF).

ix. Create six final databases which will contain the vegetation class and water regime query selections: AB – aquatic bed, EM – emergent, FO – forested, SS – scrub shrub, UB – open water, US – mud or sand, A – temporarily flooded, C – seasonally flooded, F – semi-permanently flooded, G – intermittently exposed, H – permanently flooded, and K – artificially flooded. Title the six file geodatabases: NMF_297_Below, NMF_305_Below, NMF_305_Above, SJB_296_Below, SJB_300_Below, andSJB_300_Above.

x. Select by attribute from NMF_Wetlands_296_Below features "ATTRIBUTE" LIKE '%AB%'. Remove all non AB dominant classes, i.e. PEM/AB4F. Export selection to NMF_296_Below file geodatabase and title the feature data class 'AB'. Repeat this process for all six vegetated classes and all six water regime selections listed in ix.

xi. Repeat the selection and export process for the remaining five basin flood zones.

xii. Open the feature data class 'AB' from NMF_297_Below file geodatabase in an ArcMap project. Right click on the Shape_Area field and select, Statistics. Copy and paste the value under Sum to a Microsoft Office Excel spreadsheet. Repeat the above process for the remaining vegetation class and water regime feature data classes of NMF_297_Below.

xiii. Repeat the above process for NMF_ Wetlands_305_Below, NMF_ Wetlands_305_Above, SJB_ Wetlands_296_Below, SJB_ Wetlands_300_Below, and SJB_ Wetlands_300_Above, feature data classes.

xiv. Select by Attribute from SJB_Restorable_297_Below, "ATTRIBUTE" = 'PEM1Adf'. Right click on the Shape_Area field and select Statistics. Copy and paste the Sum value into an Excel spreadsheet. Repeat the process for the following restorable wetland codes: PEM1Adf, PEM1Af, PEM1Afx, PEM1Ahf, PEM1Adf, PEM1Af, PEM1Afx, PEM1Ahf, and PEM1Kf.

xv. Repeat the above process for NMF_ Restorable_305_Below, NMF_ Restorable_305_Above, SJB_ Restorable_296_Below, SJB_ Restorable_300_Below, and SJB_ Restorable_300_Above, feature data classes.

xvi. Convert all of the Shape_Area copy and pastes from square meters to acres. Select a cell for output and type =. Then select the first cell to convert / 4046.86. This will divide the chosen cell by the above number and give an output in acres.

xvii. Click in the output cell and drag down to through the remainder of the column. This will convert the remainder of the associated column to acres.

xviii. Copy and paste special, select values and two decimal places to retain the final output conversion from square meters to acres. Delete the square meters column and repeat for the remainder of the columns. Save when finished.

Responsible Staff: David Rokus

8. Reports and Final Version of Map, Report on Methodology:
Reporting is a key step in documenting progress, methods and techniques for the lifecycle of any project. GeoSpatial Services will provide the above listed deliverables packaged into a zipped file for submission.

The final project report will include all procedures, tools, metadata and other resources used for preparing the final wetlands map product and will summarize the accuracy and completeness of the final map product.

Responsible Staff: Andrew Robertson, David Rokus

Supplements:

Wetlands in agricultural areas that are for crop harvest or planted for pulp production are delineated and classified as restorable wetlands. This data is created based on the identification of representative signatures corroborated in the field at site-specific investigations and through analysis of collateral imagery, soils, and topographic maps. Tom Dahl, Chief, National Standards and Support Team, for NWI, confirms that current photointerpretation methods allowed for the capture of restorable wetlands covering broad areas, such as the Mississippi River Floodplain.

Mr. Dahl's guidance provides assurance that these types of farmed wetlands are mapped within NWI standards. *In the past, the farmed "f" wetland modifier, had been limited to the application of 1) farmed prairie potholes and pothole type depressions, 2) farmed intermittent lake bottoms (playa lakes), 3) cranberry bogs, and 4) diked, former tidelands.

In addition, NWI Region 3 coordinator Brian Huberty approves the use of dual special modifers to properly represent these wetlands are tilled and drained - PEM1Afd, Permission was granted to combine the farmed modifier with scrub shrub class to represent cottonwood trees planted for paper pulp production - PSS1Af. The farmed special modifier is used with artificially flooded regime to attribute rice farm fields - PEM1Kf.

These attributes are flagged as incorrect by the NWI Verification Tool 10.0. The emergent farmed wetlands – PEM1Adf, PEM1Cfh, PEM1Kf and etc. were exported to a separate feature class titled, Restorable_Wetlands. The wet cottonwood plantations – PFO1Af, PSS1Af, and PSS1Cf remain in the final database, NWI_polygons or CONUS_wet_poly.

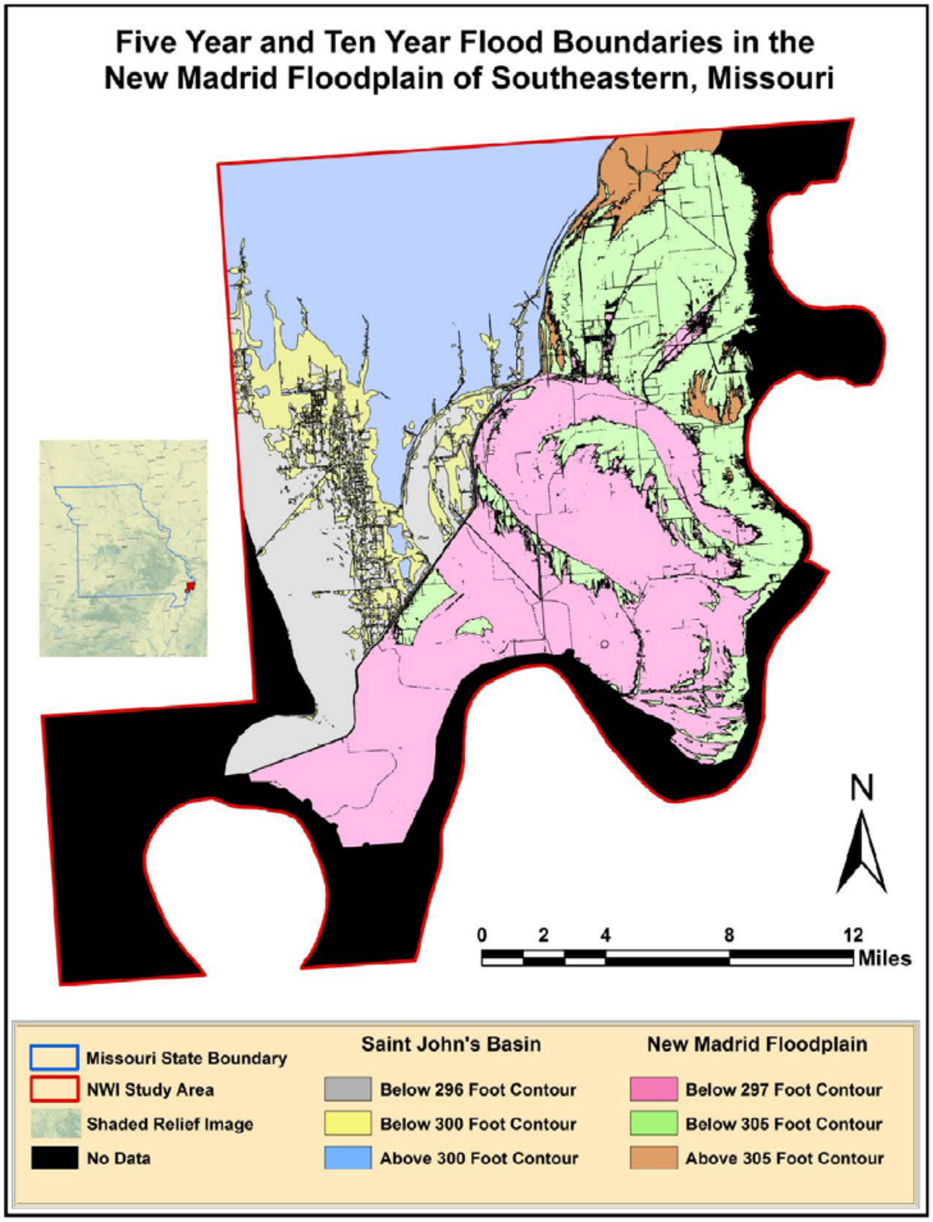
*NWI (National Wetlands Inventory). 1995. Photointerpretation conventions for the National Wetlands Inventory. St. Petersburg, FL: U.S. Fish and Wildlife Service.

Disclaimer:

This data is a preliminary draft of the final NWI update that will be submitted to the USFWS and NWI Program for review. Once USFWS quality control is complete, the data will be added to the National Wetlands Mapper site for public distribution.

The intention of the NWI is to provide habitat (not jurisdictional) wetland maps for a variety of management activities such as to help estimate fisheries and wildlife populations, document habitat change, and landscape restoration. The users of this information should note that these maps are a snapshot in time and the landscape constantly changes. There may be errors in the dataset because it is impossible to physically visit and verify every wetland. Through the art and science of geospatial analysis and image interpretation, these maps reflect a relative accuracy given the data sources, technology and funding limits at the time of the project.

GeoSpatial Services • Saint Mary's University of Minnesota
700 Terrace Heights • Winona, MN 55987 USA • Office: 507-457-8746 • Fax: 507-457-6604 • www.geospatialservices.org



GeoSpatial Services • Saint Mary's University of Minnesota
700 Terrace Heights • Winona, MN 55987 USA • Office: 507-457-8746 • Fax: 507-457-6604 • www.geospatialservices.org

Appendix B

Technical Comments on

USACE 2013 Appendix G

Fish Access Study

USFWS Technical Review Comments Appendix G , DEIS St. Johns Bayou New Madrid Floodway Project, July 2013

Comments are organized following Appendix G report structure

General comments on Appendix G and Background Section

The study is intended to address fish passage through a control structure. There are few empirical data of the effects of a control structure on the ecosystem processes that drive floodplain benefits for fisheries ecology. As the Authors note in the Introduction for Part 1, "…*alluvial floodplain deposits are typically rich in organic material*…." Eliminating those rich organic deposits may make the issue of fish access to the floodplain irrelevant. For example, closing the gates during flood events may starve the floodplain ecosystem of critical allochthonous carbon inputs that would fuel floodplain productivity. In turn, the benefits of floodplain productivity to the main channel of Mississippi River may be limited if gates are closed.

It does not appear that alternative hypotheses to explain the data results were considered, and is a consistent theme throughout the Appendix G report. We suggest more rigorous critical consideration for alternative explanations to the data would improve the report's value to managers and decision makers, and offer perspective on the uncertainties inherent in the proposed hypothesis.

Objective 2 in the Background section seems incomplete because it addresses only one component (i.e., fish access) of the proposed culvert on the functional processes required to benefit floodplain fishes. The study's focus on only passage for fish ingress and egress fails to address the culvert's effect on critical ecological processes inside the floodplain. Thus, the study will have limited utility in predicting the full extent of impacts to complex floodplain processes relevant to fisheries ecology. The proposed project area (130,000+ acres) dwarfs the scope of any other study of "important species" (e.g., species of conservation concern, recreationally and commercially significant species) in an off-channel habitat. Thus, the study area is unique and carries sufficient weight to effect implications about the complexity of floodplain processes relevant to fisheries ecology, such that appropriate data to address fisheries issues beyond simple fish passage should be included as a fundamental objective of this study. Such information is critical to adequately inform management decisions as part of project planning and eventual implementation should that occur. Results from this fish passage study should not be used beyond the study's scope to speculate that there are no ecosystem level effects of a closing structure culvert on the interactions between river and floodplain to support functional processes and floodplain productivity.

Part 1

Analyses

The authors used square root transformation on fish abundance data for use in multivariate analyses. However, square root transformation is usually more appropriate for percent formatted data, thus we suggest using a version of a log transformation to address the dataset assumptions.

Results and Discussion

Comparison of Fish Fauna:

We do not think the one-way analysis of similarity (ANOSIM) global R statistic of $R = 0.329$ necessarily support the author's conclusion that the fish assemblage was significantly different between the two systems (St. Johns vs. New Madrid). The authors cite Clarke and Warwick (2001) to support their interpretation of the global R statistic; however, Clarke and Gorley (2001) provide a more detailed guide to interpreting the R statistic from ANOSIM procedures. According to Clarke and Gorley (2001), fish assemblage similarity among sampled populations tested with an ANOSIM procedure can be interpreted as follows: $R > 0.75$ is "well separated"; $R > 0.50$ is "overlapping but clearly different"; $R < 0.25$ is "barely separable at all." Using that approach, an $R = 0.329$ would indicate a "significant overlap in fish assemblage composition with minor variation between the two systems," rather than "significantly different" as the authors assert.

Environmental Conditions:

Based on the one-way analysis of similarity (ANOSIM) global R statistic of $R = 0.282$, it does not appear that environmental conditions were significantly different between the two systems (St. Johns vs. New Madrid), in contrast to the authors' conclusions. The authors cite Clarke and Warwick (2001) to support their interpretation of the global R statistic; however, Clarke and Gorley (2001) provide a more detailed guide to interpreting the R statistic from ANOSIM procedures. According to Clarke and Gorley (2001), environmental condition similarity among sampled populations tested with an ANOSIM procedure can be interpreted as follows: $R > 0.75$ is "well separated"; $R > 0.50$ is "overlapping but clearly different"; $R < 0.25$ is "barely separable at all." Using that approach, an $R = 0.282$ would indicate a "significant overlap in fish assemblage composition with any variation between the two systems being barely separable at all," rather than "significantly different" as the authors assert.

The authors conclude this subsection by stating that the fish assemblages in both systems were dominated by tolerant, ubiquitous species. This statement seems counter to their assertion that both the fish assemblage composition and environmental conditions were significantly different between the two systems. The authors should provide additional justification for and clarity to their study conclusions.

Summary

The summary should clarify how the information about reproductive guilds is relevant to Part 1, Objectives. In addition, the Methods and Results sections should include relevant information about the use of reproductive guilds to compare fish assemblages between the two systems.

The authors suggest that a higher abundance (although not supported by objective statistical rigor) of darters and minnows in St. Johns Basin indicate that it has higher habitat value than the New Madrid Floodway. However, in contrast to that assertion, Table I-1 shows half the fishes collected in St. Johns Basin were the non-native, highly “tolerant” western mosquitofish, and that western mosquitofish were nearly twice as abundant in St. Johns Basin than in the New Madrid Floodway (where they accounted for only one-third of the catch). Based on the information presented, the reader is not left with any clear conclusions or recommendations about habitat quality in the two basins. The inconsistencies in interpreting results (e.g., St. Johns purported higher habitat value) and lack of objectivity in Methods (e.g., ANOSIM R statistic) raises questions about how well the general study purpose fits the stated study objectives.

For example, the authors devote a surprisingly (given this is a *Summary* section) lengthy block of text to asserting floodplain fishes are “tolerant,” then provide a subtle clue about their perceived relationship between tolerant fishes and low habitat/species value. Providing a habitat quality assessment, however, was not part of the study objectives. We recommend the authors consider alternative interpretations and explanations for their study results. For example, the processes of natural selection and the fluctuating nature of floodplain environments dictates that fishes using floodplains be adaptable to rapid and/or extreme shifts in conditions (e.g., water level, water chemistry). Such tolerance is not a signal of low “value,” but instead a specialized adaptation to harsh and unstable environments (e.g., see Matthews 1987) that should be protected and conserved, similar to the adaptions of fishes in coastal marshes.

Part 2

This study appears to have little relevance to fish spawning and rearing habitat that was identified as a driving issue in the Background and Part 1 Summary sections. While using telemetry techniques to assess fish passage through the proposed culverts is an interesting question it is only part of the equation. Just as relevant to address with the methods used is the extent that fishes used the floodplain for spawning and whether or not residence time was related to water level. A second, but equally important task is to quantify the relationship between offspring recruitment success and water levels.

Part 3

Objectives

Objective 1, “Document methodology and assumptions used to calculate impacts”, was not addressed.

HSI values Assumptions

Does not address progressive life stages with 15-50 year floods, nor does it account for ecosystem processes for filter feeders. In addition, it does not address growth potential with reduced competition. The model only assumes spawning and early life recruitment rather than attempting to quantify it.

Impact Assessment

Limiting model function to within the two-year flood frequency largely ignores long lived fishes that can have varying spawning responses that are tied to flood height, like paddlefish. Pallid sturgeon have been known to hold eggs (i.e., not spawn) if conditions are not appropriate (e.g., spawning cues not met).

Justification under bullet number 6) a. (pg. 34) is weak because paddlefish move hundreds of miles and can stay on floodplains for extended periods. Also, the data reported in Part 2 Table II-3 shows that average total distance moved by fishes was 36.9 miles.

Fish Access

An equally, or more important, concern than fish access is rearing capacity and function on the floodplain. Access seems somewhat irrelevant if functional rearing habitat is not available. The study methods should indicate where tagged fish were released as well as how far they had to move before passing through the culvert. In addition, all assumptions should be explicitly addressed by the data.

<u>References used by Reviewers:</u>

Clarke, K.R. and R.N. Gorley. 2001. PRIMER v6: User Manual/Tutorial. PRIMER-E Ltd., Plymouth.

Matthews, W. J. 1987. Physiochemical tolerance and selectivity of stream fishes as related to their geographic ranges and local distributions. Pages 111-120 *in* W. J. Matthews and D. C. Heins, editors. Community and evolutionary ecology of North American stream fishes. University of Oklahoma Press, Norman, OK.

Appendix Q
Part 2

Previous U.S. Fish and Wildlife Coordination

U.S. Army Corps of Engineers
Memphis District

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
608 East Cherry Street, Room 200
Columbia, Missouri 65201
Phone: (573) 876-1911 Fax: (573) 876-1914

JUN - 7 2000

Colonel Daniel W. Krueger
District Engineer
Memphis District, Corps of Engineers
B-202 Clifford Davis Federal Building
167 North Main Street
Memphis, Tennessee 38103-1894

Dear Colonel Krueger:

Enclosed is the Fish and Wildlife Coordination Act (FWCA) Report for the East Prairie Phase of the St. Johns Bayou and New Madrid Floodway Project. The project as described in your agency's supplemental draft environmental impact statement (DSEIS) would enlarge selected drainage ditches in the St. Johns basin and construct pump stations in the St. Johns basin and the New Madrid Floodway. It would also include a separately authorized levee closure in the New Madrid Floodway. Our report contains the findings of the U.S. Fish and Wildlife Service's (Service) analyses and recommendations regarding the proposed project and constitutes the report of the Secretary of the Interior as required by Section 2(b) of the FWCA (U.S.C. 661 *et seq.*). We have coordinated this report with the Missouri Department of Conservation and have enclosed a copy of their comments.

Both project alternatives analyzed in detail (i.e., Authorized Project and the Avoid and Minimize Alternative) in the DSEIS would lead to significant losses of fish and wildlife resources, including some of the largest wetlands losses in the State of Missouri in two decades. Our recommendations to your agency to modify the St. Johns Bayou and New Madrid Floodway Project to substantially reduce predicted environmental impacts were not included in the proposed alternatives that were considered in detail. The current preferred alternative would still result in severe adverse impacts to natural resources that the Department of the Interior holds in Federal trust for the citizens of the United States.

Specifically, the Service opposes the St. Johns Bayou and New Madrid Floodway preferred alternative because:

1.) The preferred alternative would cause substantial, irretrievable losses of nationally significant fish and wildlife resources and greatly diminish rare and unique habitats found in southeast Missouri;

2.) The project will likely cause a significant reduction in fishery resources because the levee closure will block the natural spring river flooding in the New Madrid Floodway, virtually eliminating fish access to shallow backwater wetlands in the floodway during the critical spawning and nursery season; and

3.) Project-related wetlands losses are at odds with the Administration's conservation policy goals and those of the Clean Water Action Plan. There will be a significant net loss of both wetland acreage and important wetland functions (e.g., inherent capacity for floodwater storage, nutrient cycling, pollution abatement, and biodiversity refugia). In part, this reflect limitations of state-of-the-art habitat assessment methodologies that are not technically sophisticated enough to accurately model many of the beneficial aspects of wetlands. Therefore, the proposed mitigation plans does not address them.

Because of the significant project-related impacts to fish and wildlife resources and the difficulty in functionally compensating those losses, the Service believes that project plans can and should be further modified to avoid those negative impacts, rather than trying to compensate for them after the damage is done. Therefore, the Service continues to recommend that the Corps consider alternatives that would provide flood protection for East Prairie, while maintaining the significant fish and wildlife values of the project area.

If the Memphis District elects to pursue a project alternative requiring extensive compensatory mitigation, we will recommend that the Corps adopt the following elements to offset project-related adverse impacts to fish and wildlife resources, and include the following commitments in the Record of Decision:

1.) Acquisition of mitigation lands in close proximity to the areas directly affected;

2.) Close replication of the types and functions of habitats lost due to project construction and operation;

3.) Maintenance of continued connectivity between the floodplain and the river, as much as possible, to perpetuate the ecological integrity of the floodplain-river ecosystem; and

4.) Completion of a substantial portion of compensatory mitigation concurrently with project construction (i.e., acquisition of mitigation lands has been completed and restoration of replacement habitats has begun before project is operated).

We appreciate the extensive help your staff provided us. Please contact Jane Ledwin at (573) 876-1911, extension 109, if you have questions or need further information.

Sincerely,

R. Mark Wilson

R. Mark Wilson
Field Supervisor

Enclosures

cc: MDC; Jefferson City, MO (Attn: Gary Christoff)
EPA; Kansas City, KS (Attn: Joe Cothern)
DNR; Jefferson City, MO (Attn: Thomas Lange)

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters

2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573/751-4115 ◆ Missouri Relay Center: 1-800-735-2966 (TDD)

JERRY M. CONLEY, Director

June 2, 2000

RECD JUN 07 2000

Mr. R. Mark Wilson
Field Supervisor
U.S. Fish and Wildlife Service
608 East Cherry Street, Room 200
Columbia, MO 65201

Dear Mr. Wilson:

Thank you for your recent letter transmitting the draft final Fish and Wildlife Coordination Act Report for the East Prairie Phase of the St. Johns Bayou and New Madrid Floodway, Missouri project. Department staff completed a review of the section titled Fish and Wildlife Conservation Measures, pp. 33-46. The Department concurs with the conclusions.

I must emphasize–as emphasized in our review of an earlier draft–that the Department remains open to working with the project sponsors and the Corps of Engineers for developing and supporting a project with little or no adverse impacts to fish, forests, and wildlife.

Sincerely,

JERRY M. CONLEY
DIRECTOR

JMC:GC:sf

c: Conservation Commission
Senator Peter Kinder
Representative Lanie Black
Representative Peter Myers

ST. JOHNS BAYOU AND NEW MADRID FLOODWAY

PROJECT

East Prairie Phase

Fish and Wildlife
Coordination Act Report

By

Jane Ledwin
Fish and Wildlife Biologist

and

Andrew Roberts
Fish and Wildlife Biologist

U.S. Fish and Wildlife Service
Ecological Services Field Office
Columbia, Missouri

May 2000

Table of Contents

ST. JOHNS BAYOU AND NEW MADRID FLOODWAY

PROJECT

East Prairie Phase

Fish and Wildlife
Coordination Act Report

By

Jane Ledwin
Fish and Wildlife Biologist

and

Andrew Roberts
Fish and Wildlife Biologist

U.S. Fish and Wildlife Service
Ecological Services Field Office
Columbia, Missouri

May 2000

Appendices

List of Figures

List of Tables

Executive Summary

This is a summary of the findings and recommendations of the Fish and Wildlife Service (Service) and the Missouri Department of Conservation (MDC) contained in the Fish and Wildlife Coordination Act Report for the U.S. Army Corps of Engineers' (Corps) St. Johns Bayou and New Madrid Floodway, Missouri, East Prairie Phase, Re-evaluation Study. The Corps has identified two alternatives that include: vegetative clearing along 4.3 miles of rural channels; channel enlargement along the St. Johns Bayou, the Setback Levee ditch, and St. James ditch east of East Prairie; and a 1,000 cubic feet per second (cfs) pumping station near the existing gravity drainage outlet in St. Johns Bayou. The project also includes a 1,500 cfs pumping station at the mouth of the New Madrid Floodway in conjunction with a separately authorized levee closure.

The St. Johns Bayou basin and the New Madrid Floodway are drainages comprising part of the historic Mississippi River floodplain, and although highly altered, still perform floodplain functions critical to regional fish and wildlife resources. The New Madrid Floodway is unique in Missouri because it is the only significant portion of the historic Mississippi River floodplain still largely connected to the river. That connection provides ecologically valuable hydrologic exchange between the Mississippi River system and adjacent terrestrial ecosystem. Large portions of Mississippi and New Madrid counties, including the project area, support a wider array of diverse habitats and natural biological communities than elsewhere in southeast Missouri (i.e., the Bootheel). That high biodiversity is reflected by the large number of state-listed plant, mussel, fish, amphibian, reptile, bird, mammal, and natural biological communities reported for the those counties, and is due in part to the influence of the Mississippi River's annual hydrologic regime on the lower St. Johns Bayou basin and New Madrid Floodway. The project area still functions as an integral part of the Mississippi River ecosystem, and provides important breeding, migration and overwintering habitat for numerous species of neotropical migratory songbirds, and migratory waterfowl, waterbirds and shorebirds. The forested wetlands in the project area, a small remnant of a once extensive floodplain complex are becoming increasingly scarce. That habitat has become so rare that it is now considered critical as refugia for a variety of scarce fish and wildlife species that formerly flourished throughout the lower Mississippi River ecosystem. In spite of extensive modification, the diverse wetland habitats within the project area support nationally significant fish and wildlife resources that enhances biodiversity state-wide and regionally, and helps preserve the ecological integrity of the lower Mississippi River.

Both proposed project alternatives will eliminate spring overbank flooding that periodically may inundate tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A wide variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals use those habitats during all or part of their life cycle. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by either project alternative. Approximately 36,313 acres of wetlands would no longer be seasonally inundated by backwater flooding under the Authorized Project alternative. Reduced flooding will result in a decrease of at least 215,000 Duck Use Days during spring migration. Project implementation will decrease fish spawning and rearing habitat values by approximately 50 percent in the St. Johns Bayou basin and at least 93 percent in the New Madrid Floodway. In addition, closing the levee to prevent natural spring flooding from the Mississippi River will virtually eliminate fish access to the Floodway during the critical spawning season.

We are greatly concerned about altering the extent and timing of seasonal flooding in the project area not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the regional ecosystem and cumulative impacts in the Lower Mississippi Valley. The Corps has proposed reforesting 9,560 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate losses of wetland habitat value, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, water quality changes, etc.. Fish and wildlife species with limited mobility (i.e., reptiles and amphibians) will experience a net loss of habitat within the project area that will not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Because the proposed alternatives will negatively affect nationally significant fish and wildlife resources in the project area, we recommend that the Corps implement the following mitigative measures to ensure that fish and wildlife receive equal consideration with other project purposes:

1.) Consider alternatives that specifically address East Prairie flooding problems, including ring levees, flood-proofing, and local drainage improvements. If additional flood control work is necessary, limit that work to the St. Johns Bayou basin. Work in the New Madrid Floodway will not provide flood relief to areas in and around East Prairie.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures.

a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. They may also function as grade control structures.

e.) Avoid dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

f.) Avoid dredging in a 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements, etc.) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the proposed alternatives, they should incorporate the following measures as integral features of the selected plan.

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns basin, and between 290 and 277 (Authorized Project) or 281 feet (A&M) NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures. (average annual acres)

1.) Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). Approximately 2,118 acres (Authorized Project) or 1,546 acres (A&M) would be needed to mitigate direct project impacts. If protective covenants have not been placed on BLH forest as described in 4(b), the Corps should reforest an additional 6,998 acres (Authorized Project) or 6,788 acres (A&M) to compensate for induced forested wetland losses because project-related reductions in flooding.

2.) Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

3.) Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below). Approximately 7,968 acres (Authorized Project) or 7,607 acres (A&M) of flooded agricultural lands would be necessary to mitigate those habitat losses.

4.) To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest an additional 2,343 acre (Authorized Project) or 1,950 acres (A&M) of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

5.) Provide shallow flooded (i.e., ≤ 18 inches) land in April and May to compensate for project-related losses in shorebird migration habitat. (Such areas could also partially compensate for losses to fisheries and waterfowl habitat.) Approximately 1,583 acres (Authorized Project) or 1,523 acres (A&M) of flooded cropland would be necessary to compensate shorebird habitat losses. Constructing moist soil areas to mitigate those losses would roughly halve the necessary acreage.

6.) Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with project construction and should be in place prior to project operation.

Service Position

The Service and the Corps have strived to develop measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate cover types (i.e., BLH, moist soil, borrow pits), only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, habitat functions must also be maintained. While the proposed mitigation plan would potentially compensate fish and wildlife habitat losses that can be quantified with current models for estimating wildlife effects of water development projects, it would not, unfortunately, sustain all the important ecologic functions of the floodplain-river ecosystem in the project area.

The Service opposes the St. Johns Bayou and New Madrid Floodway preferred alternative because:

1.) As proposed, the preferred alternative would cause substantial, irretrievable losses of nationally significant fish and wildlife resources, and greatly diminish rare and unique habitats found in southeast Missouri.

2.) We believe project-related wetlands losses are at odds with the Administration's conservation policy goals and those of the Clean Water Action Plan.

If the Corps proceeds with project construct, at a minimum, they should include the Service's above-mentioned recommendations as integral components of the project.

Introduction

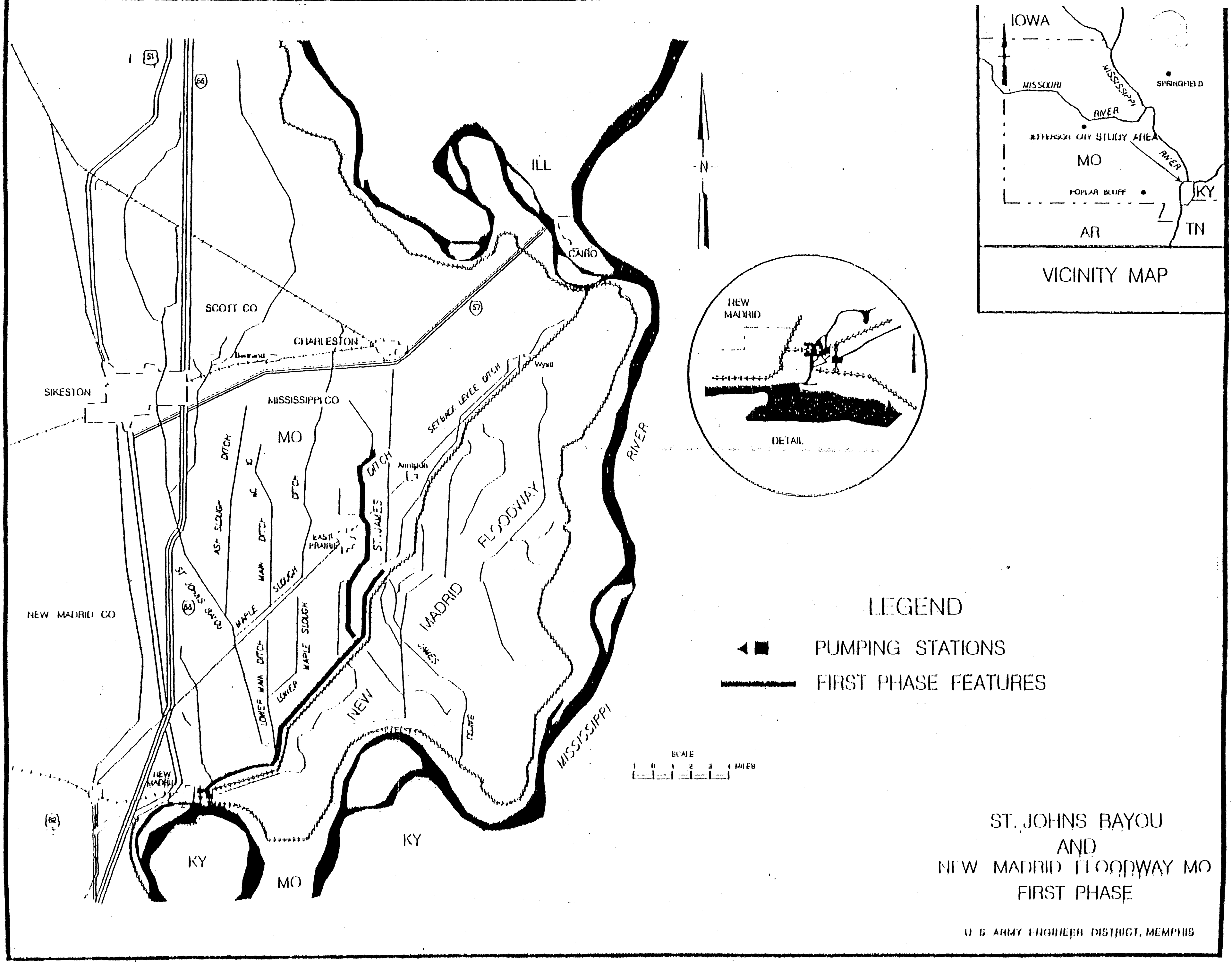
The St. Johns Bayou and New Madrid Floodway Project was authorized for construction by the Water Resources Development Act of 1986. The original project included 130 miles of channel widening and clearing, construction of a 1,000 cubic-feet-per-second pump station at the outlet of St. Johns Bayou, construction of a 1,500 cfs pump station at the outlet of East Bayou (Mud) Ditch on the Floodway, and several mitigation features. The project also included closure of a 1,500-foot gap in the Mississippi River Frontline Levee at the lower end of the New Madrid Floodway authorized by the 1954 Flood Control Act. A Feasibility Report and Environmental Impact Statement for the original project were filed in 1976 and a Supplemental EIS was completed in 1982. The U.S. Army Corps of Engineers (Corps) completed the Phase II General Design Memorandum in 1986, and it serves as the basis for the current re-analysis. The original project was never constructed because the local sponsor(s) could not meet cost-share requirements.

In 1996, Congress appropriated funds for the Corps to reformulate the original project. At the same time, the U.S. Department of Agriculture (USDA) designated the community of East Prairie, Missouri, which lies within the St. Johns Bayou basin, an Enterprise Community. In addition, the 1996 Water Resources Development Act exempted the East Prairie Phase from normal cost-sharing requirements, allowing USDA funds allotted to the community of East Prairie to be used to fulfill non-federal cost share requirements for a reformulated East Prairie Phase of the project. The purpose of the East Prairie Phase of the St. Johns Bayou and New Madrid Floodway Project is economic and infrastructure development in the project area (U.S. Army Corps of Engineers 1997). It includes 23.4 miles of channel work within the St. Johns Bayou basin, the St. Johns Bayou pump station, the New Madrid Floodway pump station, and the frontline levee gap closure. The project will provide a 25-year level of flood protection to the immediate area in and around East Prairie, and a 1.1-year level of flood protection to the New Madrid Floodway.

Description of Project Area

The St. Johns Bayou and New Madrid Floodway Project is located in southeast Missouri, adjacent to the Mississippi River and includes all or portions of New Madrid and Mississippi Counties (Figure 1). The project area extends from the vicinity of Commerce to New Madrid, Missouri. The area is divided into two drainage basins; the St. Johns Bayou basin and the New Madrid Floodway. The East Prairie Phase covers only those portions of the basins that provide the greatest benefits to East Prairie.

The St. Johns Bayou basin covers approximately 324,173 acres and is drained by St. Johns Bayou through the Birds Point to New Madrid Setback Levee ditch via a gravity drainage structure near the City of New Madrid. The area is approximately 40 miles from north to south and reaches a maximum width of 25 miles. The basin has very low relief, ranging from 280 to 325 feet National Geodetic Vertical Datum (NGVD).


VICINITY MAP
IOWA
MISSOURI RIVER
MISSISSIPPI RIVER
SPRINGFIELD
STUDY AREA
MO
POPLAR BLUFF
KY
AR
TN
ILL
N
CAIRO
SCOTT CO
CHARLESTON
SIKESTON
MISSISSIPPI CO
MO
NEW MADRID CO
SETBACK LEVEE DITCH
ST. JAMES DITCH
EAST PRAIRIE
ASH SLOUGH DITCH
MAIN DITCH
MAPLE SLOUGH
LOWER MAIN DITCH
LOWER MAPLE SLOUGH
ST. JOHNS BAYOU
NEW MADRID FLOODWAY
NEW MADRID
MISSISSIPPI RIVER
KY
MO
NEW MADRID
DETAIL
SCALE
MILES
LEGEND
PUMPING STATIONS
FIRST PHASE FEATURES
ST. JOHNS BAYOU
AND
NEW MADRID FLOODWAY MO
FIRST PHASE
U. S. ARMY ENGINEER DISTRICT, MEMPHIS

The New Madrid Floodway is approximately 33 miles long with a maximum width of 10 miles and covers 132,602 acres. The Floodway was authorized by the Flood Control Act of 1928 and constructed in the 1930s. In the event of a Mississippi River project flood, the Corps would breach the mainline levee along the Floodway to reduce flood stages in the vicinity of Cairo, Illinois and Paducah, Kentucky. The Floodway is bounded on the west by the Setback Levee, on the east by the Mississippi River Frontline Levee, and on the south by the Mississippi River. The upper third of this basin drains through a culvert in the Frontline Levee or via the Peafield Pumping Station during high river stages. The lower two-thirds of the basin drain through St. Johns Diversion Canal and Wilkerson Ditch into East Bayou Ditch (Mud Ditch) and then into the Mississippi River. Similar to St. Johns Bayou basin, the Floodway has little relief; elevations range between 280 and 315 feet NGVD. The New Madrid Floodway is unique in that it is the only significant portion of the historic Mississippi River floodplain in Missouri still largely connected to the river.

Originally part of the Mississippi River floodplain, both basins have been highly modified by intensive agriculture, the primary land use. St. Johns Bayou basin and the Floodway have approximately 280,290 and 113,006 acres in production, respectively. The primary crops are soybeans, corn, cotton, wheat and milo. In addition to agricultural acreage, there are approximately 30,463 acres of wooded habitat in the project area.

Fish And Wildlife Resources

Wetlands

Historically, the project area was covered by a mosaic of river meanders, oxbows, natural levees, forested wetlands, marsh, and open water. Federal flood control projects and Federal and local drainage projects, however, have significantly altered the hydrology of the project area. Of an original 2.5 million acres of forested wetlands in southeast Missouri, approximately 50,000 acres remain (L.H. Fredrickson, cited in MDC 1989). The Corps used aerial photography to develop a land-use cover map for the project area and acreage estimates for wetlands in each basin (Table 1).

Within the project area, there are approximately 10,207 acres of forested wetlands. Most of those acres are bottomland hardwood (BLH) forests found along the lower reaches of St. Johns Ditch in the St. Johns Bayou basin, and adjacent to the Ten Mile Pond Conservation Area and Big Oak Tree State Park in the Floodway. BLH forests are subject to regular seasonal flooding most years. The Missouri Department of Conservation (MDC) has identified several significant examples of this rare community that occur in the project area (MDC 1999). The extent and duration of flooding determines the vegetation structure in any particular area resulting in an extremely diverse plant community. Tree species typically found in those forests are overcup oak, Nuttall oak, pin oak, willow oak, swamp chestnut oak, cherrybark oak, bald cypress, tupelo gum, sweetgum, sugarberry, green ash, pumpkin ash, American elm, black willow, black gum, cottonwood, water hickory, and red maple. Many of the forests in the project area also contain

Table 1. Wetland acres in the St. Johns Bayou basin and New Madrid Floodway.

Landcover type	St. Johns Bayou basin	New Madrid Floodway
forested wetlands	4,473	5,734
scrub/shrub marsh	13	194
herbaceous vegetation	2,045	1,938
cropland	22,999	27,903
pasture	135	206
sand bar	11	NA
open water	944	797
urban	2	NA
Total	**30,622**	**36,773**

understory composed of swamp privet, buttonbush, possumhaw, sweet greenbriar, poison ivy, trumpet creeper, Virginia creeper, blackberry, and various herbaceous species.

The remainder of forested wetlands in the project area include riparian forest and swamp. Riparian forests have vegetation similar to BLH forests, and are found along the St. Johns Bayou, St. Johns Ditch, Mud Ditch, and most of the large drainage ditches. Swamps are found along old oxbows and permanently flooded lakes and ponds. They are often flooded a significant portion of the growing season, and in some cases all year. While swamps may contain tree species found in drier forests, the majority of vegetation consists of bald cypress, tupelo gum, red swamp maple, black willow, box elder, buttonbush, swamp privet, duckweeds, lizard's tail, and numerous other herbaceous species. MDC has identified several significant examples of this increasingly rare community that occur in the project area including Big Oak Tree State Park, Ten Mile Pond and Weasel Woods (MDC 1999).

Scrub/shrub marsh and freshwater marsh are found in much smaller quantities in both basins, most of which is located on public land (e.g., Ten Mile Pond Conservation Area and Big Oak Tree State Park) and along perennial stream and lakes. Common shrub species in those habitats include young black willow, box elder, red maple, buttonbush, and swamp privet. Herbaceous species include *Carex* spp., cattail, giant cane, lizard's tail, smartweeds, and aquatic plants such as water lotus, coontail, duckweeds, Elodea, and water primrose.

The vast majority of the study-area wetlands, approximately 50,900 acres, consists of wet croplands dissected by numerous ditches and scattered tracts of BLH forest. Most of that acreage, especially the lowest, most flood-prone lands, is planted in soybeans. The remaining wetlands are largely composed of 4,000 acres of wet herbaceous vegetation, much of which are adjacent to croplands and levees. Although such habitats have been highly altered, they can provide valuable wintering, migration, and breeding habitat for numerous species of fish and wildlife depending on the period and depth of inundation.

Open Waters

Permanent open water in the project area consists of natural streams, oxbows and ponds, ditches, and borrow pits. The sand and gravel alluvium underlying much of the lowlands act as a vast reservoir for storing precipitation. This water reserve is released slowly into the ditches creating well-sustained base flows (Pflieger 1997). The riparian corridor along many reaches of the major drainage ditches, streams, and borrow pits provides shade needed to sustain aquatic life by maintaining moderate summer water temperatures. These waterways vary greatly in size, current velocity, water clarity, depth, and amount of aquatic vegetation. Some ditches also contain deeper pools, woody debris, and a variety of emergent and submergent vegetation (Pflieger 1997). Lentic habitats (i.e., borrow pits, oxbow lakes, and ponds) also contribute to habitat diversity in the project area, which in turn supports an extremely diverse shellfish and finfish fauna.

Another critical component of project-area waters are temporary ponds and overflow areas. Although localized rainfall can produce these ephemeral features, particularly in the St. Johns Bayou basin, inundation from the Mississippi River produces up to tens of thousands of acres of this habitat annually. Such areas hold water for only days or weeks, yet are critical to migratory birds and breeding reptiles, amphibians, and fish.

Wildlife Resources

In the project area, waterfowl are present throughout year. Wood duck, and to a lesser extent, mallard, hooded merganser and blue-wing teal, breed in the project area. During migrations and overwintering, the St. Johns Bayou basin and the New Madrid Floodway are important areas for hundreds of thousands of dabbling ducks (i.e., mallard, gadwall, green and blue-wing teal, pintail, widgeon, shoveler, and black duck), coots, and geese. Diving ducks, such as lesser scaup, ring-neck, and canvasback use the deeper waters of the project area. Migration is a slow, drawn-out process during which waterfowl require feeding and resting habitat. Earliest fall migrations of waterfowl occur in mid-August when the first flocks of blue-wing teal arrive. Fall migration continues through late December and even early January as more winter hardy species make their way south. Fall/winter migration has barely concluded before early migrants fly north. Wintering may occur at various latitudes and is dictated by habitat availability and freeze up. Spring migration through the project area generally concludes by mid-March as the last of the shovelers and blue-wing teal depart. Because of their importance to waterfowl, wetlands in the project area are a key component in the Lower Mississippi Valley Joint Venture, a feature of the North American Waterfowl Management Plan (MDC 1989).

The diverse habitat in the project area also supports hundreds of water-dependent and terrestrial bird species, both during breeding and migration. Although there are no heronries in the project area, wading birds such as the great blue heron, little blue heron, great egret, snowy egret, and yellow-crowned night heron depend on project area wetlands as foraging habitat. During migration thousands of shorebirds, such as greater yellowlegs, killdeer, dunlin, short-billed dowitcher, lesser golden-plover, semipalmated plover and solitary sandpiper, rely on shallow water, overflow areas to forage, replenishing critical energy supplies for the flight to northern breeding grounds. Forested wetlands have been found to support a significantly higher abundance and diversity of birds species compared to upland forests (Brinson et al. 1981). In the project area, numerous species of raptors, woodpeckers, warblers, thrushes and flycatchers use BLH forests as migration and breeding habitat. The State-listed Mississippi Kite (rare) has been known to nest in BLH forests within the project area. Recent research, however, has pointed to sharp population declines in several neotropical migratory songbird species (e.g., white-eyed vireo, northern parula, cerulean warbler), particularly those that require large forested tracts to successfully reproduce (Robbins et al. 1989, Askins et al. 1990). In the Lower Mississippi Valley, the Partners in Flight Program is focusing on forested wetlands conservation because 13 of the 14 priority species require BLH forests for breeding. The Service, state agencies and the private sector are developing management objectives to protect forest breeding birds and their habitats in the Mississippi Alluvial Valley. As part of that effort they have identified "birds conservation areas" (i.e., forest patches 10,000 acres or greater to support long-term, self sustaining populations of forest breeding birds) that contain cleared areas to potentially be reforested. Several of those areas are in or near the project area (Figure 2).

Important game mammals that occur in the project area include white-tail deer, eastern gray and fox squirrels, State-listed rare swamp rabbit and eastern cottontail rabbit. The mink, beaver, raccoon, and muskrat are economically important furbearers found in the project area. Other common mammals found in the project area are striped skunk, coyote, red fox, various rodents, and big and little brown bats.

Johnson (1997) notes that "The native swamplands of southeast Missouri provide unmatched habitat for many species of amphibians and reptiles...." Amphibians expected to occur on stream and lake edges, ponds, and in forested wetlands in the project area include the western lesser siren, marbled and small mouth salamanders, Fowler's toad, eastern narrow-mouthed toad, spring peeper, green treefrog, and bronze frog. Wetlands in the project area also support a number of State-listed rare species including the three-toed amphiuma, Illinois chorus frog, and the eastern spadefoot toad. Reptiles found in sloughs, swamps, ditches, oxbows, and ponds in the project area include Mississippi mud turtle, stinkpot, southern painted turtle, State-listed rare western chicken turtle, red-eared slider, alligator snapping turtle and the eastern spiny softshell, broadhead skink, black rat snake, State-listed rare dusky hognose snake, speckled king snake, water snakes, western ribbon snake, eastern garter snake, and rough green snake.

Aquatic Resources

The network of drainage ditches in southeast Missouri was largely constructed at the turn of the century when the region was converted to agricultural land. This development replaced the majority of the natural landscape leaving the ditches as the principal habitat for aquatic resources (Pflieger 1997). Changes in the aquatic fauna were undocumented, but this large-scale disturbance undoubtedly altered the original assemblage of species. Many species characteristic of lowland habitats have managed to persist in the area, but not necessarily in their former

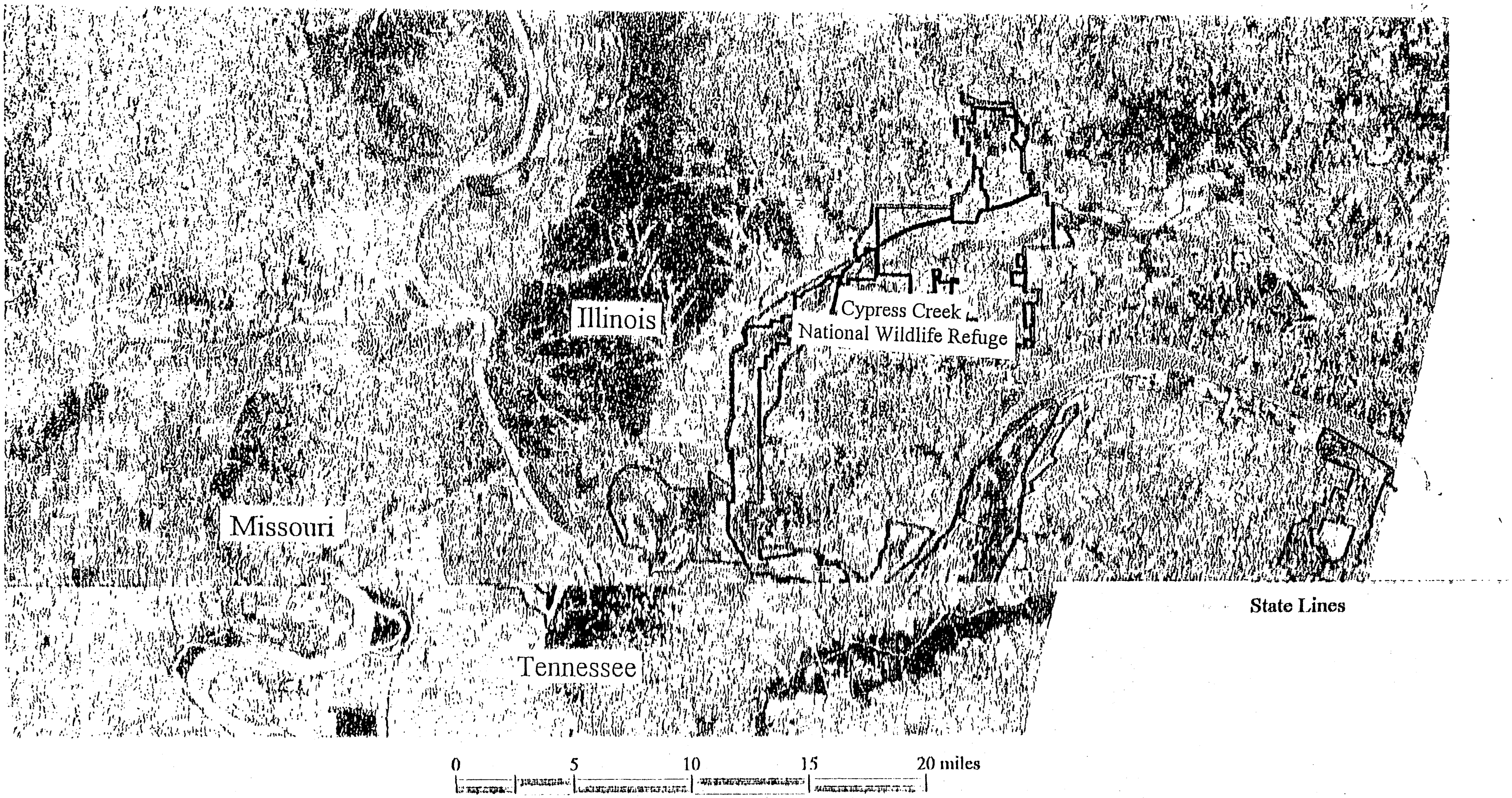


Figure 2. Forest Bird Conservation Areas in and around the St. Johns Bayou/New Madrid Floodway project area

abundance. Other species that were able to exploit ditch environments may have benefitted from the altered conditions.

The project area supports a remarkably rich and distinctive fishery. In all, 114 species representing 22 families have been collected from the project area-drainages and the Mississippi River (Appendix A, Table A-1). Of these species, 93 have been collected from ditches and bayous in the project-area drainage (Sheehan et al. 1998, MDC 1997). The remaining 21 species have been collected from the Mississippi River proper (U.S.G.S. 1991-1996, MDC 1997). Of the 93 species collected from the project area, 10 are considered endangered, rare, or on the watch list in the state of Missouri. One species, the golden topminnow, once believed to be extirpated from Missouri, was collected recently from the St. James Ditch (Sheehan et al. 1998). Many fish species collected in the St. Johns Bayou basin and the Floodway are either confined to the Mississippi lowlands or occur only occasionally elsewhere in the state (Pflieger 1997). The diversity and abundance of the fish fauna reflects the regionally-rare and diverse aquatic habitats in the project area (see above).

The New Madrid Floodway is the only portion of the historic Mississippi River floodplain and its tributaries in Missouri still connected to the river. Annual flooding in the Floodway is an important natural cycle of the Mississippi River. Backwater flooding in that area provides significant spawning, nursery, and foraging habitat for river fish (Sheehan et al. 1998). This event greatly enhances fish stocks and plays an important role in maintaining fish diversity in the Mississippi River and its floodplain. Most of the fish species that have been collected in the project area use the inundated floodplain for rearing and spawning or depend on free access to small tributaries such as Mud Ditch during their reproductive season in the spring (Sheehan et al. 1998). Baker et al. (1991) noted that floodplain ponds support some of the most unusual fish communities in river systems. Uncommon species characteristic of that habitat include chain pickerel, golden topminnow, flier, banded pygmy sunfish, and the cypress, mud, bluntnose and slough darters, all of which have been documented from the project area (MDC 1997, Sheehan et al. 1998, U.S.G.S. 1991-1996).

Recent sampling in the project area has documented significant fish production from flood waters. Sampling of Mud ditch and St. Johns Bayou below the outlet structure in 1993 and 1994 (mid-May to early July) collected large numbers of young-of-the-year (YOY) fishes. Those collections were made as backwaters drained to the Mississippi River (John Tibbs, Texas Wildlife and Parks, pers. comm.). The YOY specimens represented 27 and 17 species in 1993 and 1994, respectively. Similar results were reported by Sheehan et al. (1998) after collecting fishes from inundated floodplain and channel habitats during a time period which coincided with a rise and fall of flood waters in the project area. Adult fish and YOY collected represented 24 species from the New Madrid Floodway and 11 species from the St. Johns Bayou basin. Adults of many species showed a reduction in gamete presence starting from the beginning of the flood pulse which suggested that spawning occurred during the flood event. The majority of species reported by Tibbs and Sheehan are river species that require quiet, off-channel habitat for spawning and rearing of young including sportfishes such as white bass and channel catfish and three species of commercially important buffalo (black, bigmouth, and smallmouth). These collections also contained extremely large numbers of YOY gizzard shad, which are a principal prey species for predaceous fishes (e.g. largemouth bass, white bass, catfishes, sauger, crappie, and gar).

Sheehan et al. (1998) also reported differences in species composition between the St. Johns Bayou basin and New Madrid Floodway. Although more shad were collected in the St. Johns Bayou basin, the New Madrid Floodway yielded twice as many YOY fish species other than shad, including white bass and buffalo species. Sampling data also suggested either a single, protracted or more than one major white bass run occurring in the New Madrid Floodway. Those species differences are believed to be related to the hydrologic connectivity (i.e., fish access) between the Mississippi River and the Floodway during the spring spawning period.

Project-area waters also support diverse sport-fish communities in both the St. Johns and the New Madrid basins that provide significant angling opportunities for the public. The recreational fisheries provided by Mud Ditch, St. Johns Bayou, and the Mississippi River are important to this area of the state because of the lack of other fishable waters in the Bootheel. The lower New Madrid Floodway is the site of an important white bass fishery. In the spring, white bass from the Mississippi River enter Mud Ditch in large numbers to spawn. This annual event attracts anglers from New Madrid as well as surrounding areas of Sikeston and Dexter, Missouri (Randy McDonough, MDC, pers. comm.). During spring flooding, several species of buffalo and carp also enter the floodway from the Mississippi River to spawn. Anglers take these fish by gigging in shallow floodplain waters. In spring, Mud Ditch also provides significant angling opportunities for crappie, channel catfish, and flathead catfish as far as Ten Mile Pond Conservation Area (Dave Wissehr, MDC, pers. comm.). Those fisheries depend on that open connection between Mud Ditch and the Mississippi River to allow those species access into the Floodway to spawn.

In addition to seasonally abundant sportfishes, the project area supports a diversity of resident sport fishes. Abundant species include channel catfish, flathead catfish, largemouth bass, bluegill, white crappie, freshwater drum, and common carp. While fishing for any of the above species, anglers can also anticipate occasional action from a variety of less common sport fishes depending on the fishing technique used. These species include: spotted bass, blue catfish, yellow bass, sauger, rock bass, black crappie, longear sunfish, warmouth, black bullhead, yellow bullhead, chain pickerel, grass pickerel, bowfin, quillback, river carpsucker, northern hogsucker, river redhorse, shorthead redhorse, golden redhorse, spotted sucker, grass carp, and bighead carp.

The drainage ditches of southeast Missouri provide significant freshwater mussel habitat. The combination of moderate depth and current velocity, stable flows, sandy substrates, substantial groundwater flow, and abundant fish hosts found in these ditches provide good conditions for a variety of unionid species. Relative to natural rivers of similar size, mussel populations in these ditches are relatively diverse, abundant, and rather uniformly distributed (Barnhart 1998). Recent studies in the lowland region show that at least 30 species of unionids presently inhabit the lowland drainage ditches (Jenkinson and Ahlstedt 1987, Ahlstedt and Jenkinson 1991, Roberts et al. 1997). Such numbers are particularly significant in light of the dramatic decline in freshwater mussels in the southeastern United States which has one of the richest mussel fauna in the world (Williams et al. 1993). That decline is attributed to habitat destruction by dams, channel improvements and siltation (Neves 1993). In addition, competition from exotic species such as the Asian clam *(Corbicula fluminea)* and the zebra mussel (*Dreissena polymorpha*) is believed to be hastening the demise of native mussel fauna (Williams et al. 1993).

In a survey of project-area drainages, Barnhart (1998) collected 24 unionid species (Table A-2), representing over one-third of those known to occur in Missouri. The highest species diversity and greatest abundance of individuals was found in the lower portions of Lee Rowe Ditch and in the Setback Levee Ditch. Species composition differed between the Floodway and St. Johns Bayou basin. Thirteen species were found in the St. Johns basin that were not found in the Floodway. Only one species, *Obliquaria reflexa*, was found in the New Madrid ditches and not in the St. Johns ditches. Four species that occur in the project area, the rock pocketbook (*Arcidens confragosus*), flat floater (*Anodonta suborbiculata*), wartyback (*Quadrula nodulata*), and Texas liliput (*Toxolasma texasensis*) are considered rare in Missouri. Of these species, the rock pocketbook and flat floater are among the most rare unionids in the State (Oesch 1995). The ditches of the Bootheel lowlands appear to provide the most important habitat for these four species within the State (Barnhart 1998).

Crayfish are one of the dominant groups of invertebrates occurring in a variety of flowing and standing-water habitats (Pflieger 1997). They are an important food source for many fish (Momot et al. 1978) and are a major food item in the diet of bullfrogs in ponds, lakes and streams (Korschgen and Moyle 1963, Korschgen and Moyle 1955). A wide variety of other wildlife species, including snapping turtles, racoon, mink, great blue heron, and belted kingfisher also prey heavily on crayfish (Pflieger 1997).

Although crayfish surveys specific to the project area have not been conducted, the Lowland Region in Missouri's Bootheel, supports a small but distinctive crayfish fauna. A State-wide crayfish survey conducted by the MDC found 10 species representing six genera in southeast Missouri (Pfleiger 1997). These species include, the shrimp crayfish (*Orconectes lancifer*), grey-speckled crayfish (*O. palmeri*), devil crayfish (*Cambarus diogenes*), White River crayfish, (*Procambarus acutus*), red swamp crayfish (*P. clarkii*), vernal crayfish (*P. viaeveridus*), Cajun dwarf crayfish (*Cambarellus puer*), Shufiddt's dwarf crayfish, (*C. shufeldtii*), digger crayfish (*Fallicambarus fodiens*), and shield crayfish (*Faxonella clypeata*). While most of these species have large distributions nationwide, the occurrence of several of those species in Missouri is limited to the bootheel. The State-listed species are the shrimp crayfish , the shield and digger crayfish, and the Cajun and Shufeldt's crayfish. Swamp and seasonally flooded roadside ditches and sloughs are important habitat these macroinvertebrates (Pfleiger 1997). The variety of ditch habitats are also important for crayfish.

Available data on the benthic larval insect fauna from the project area is limited to a small number of collections made in St. Johns ditch in 1995 and 1996. Those samples revealed a surprisingly diverse non-dipteran insect community (Samuel McCord, QST Environmental, pers. comm.). Several "intolerant" taxa were found including *Perlesta* (Plecoptera), *Brachyucentrus*

(Trichoptera, caddisflies) and *Ploycentropus* (Trichoperta). The presence of these species indicates good water quality and favorable conditions. Dominance of dipteran (flies) taxa usually indicates polluted waters.

Endangered Species

Two federally listed endangered species, the interior least tern (*Sterna antillarum athalassos*), and pallid sturgeon (*Scaphirhynchus albus*), and one federally listed threatened species, the bald eagle (*Haliaeetus leucocephalus*), occur in the project area. That area is also within the historic range of the endangered fat pocketbook pearly mussel (*Potamilus capax*).

Interior least terns nest in colonies on barren sandbars in the Mississippi River adjacent to the New Madrid Floodway. Based on a 1999 census, there were seven tern colonies within several miles of the project area (Jones 1999). Both adult birds and chicks require an abundant supply of small fish, and adults may forage for fish up to two miles from the nest site. Large numbers of adult terns have been observed foraging in the spring (mid to late May) in the lower end of St. Johns Bayou below the outlet structure and its confluence with Mud Ditch, because of the availability of large numbers of forage fish (Katie Dugger, University of Missouri, pers. comm.) as the backwater drained to the river.

Both adult and juvenile pallid sturgeon are reported from the Mississippi River and associated off-channel habitats in the project area. MDC documented a juvenile pallid sturgeon that was released in the Middle Mississippi River and later caught in a river backwater near Point Pleasant, Missouri (River Mile 878) in 1994. Nine of the sub-adult pallid sturgeon released by MDC into the Mississippi and Missouri rivers have been recaptured in tributaries or tributary confluence areas. Commercial fishermen report capturing adult pallid sturgeon in these same habitats. While these data suggest that connected tributaries and backwaters of the Mississippi River, such as Mud Ditch and the New Madrid Floodway, may be important feeding habitats or refugia for some life stages of pallid sturgeon, most adult pallid sturgeon from the lower river have been captured over sand in deep, main channel habitats with current (Reed and Ewing 1993, Constants et al. 1997).

Low numbers of wintering and nesting bald eagles (*Haliaeetus leucocephalus*) occur along the Mississippi River in New Madrid and Mississippi counties. In early 1998, three bald eagle nests (one of which is active) were observed in the project area near Hubbard Lake. That year the active nest contain one chick (Chris Mills, pers. comm.) In 1999, that nest fledged 2 young. Bald eagles generally build nests in the tops of large bald cypress or cottonwood trees near water. Their diet consists of fish, although waterfowl and small mammals will also be taken. Waterfowl is particularly important to wintering bald eagles who often are associated with major waterfowl concentration areas. Just south of the Floodway, eagles successfully fledged young at Donaldson Point Conservation Area in 1992 and have made several nest attempts elsewhere in Mississippi County.

The project area is within the range of the federally endangered fat pocketbook mussel, *Potamilus capax*. This species was historically widespread and ranged from the Mississippi River, Minnesota, southeast to the Wabash and Ohio rivers and west to the St. Francis River drainage of Arkansas. Currently, fat pocketbook mussels are limited to the St. Francis River drainage in Arkansas, the lower Wabash and Ohio Rivers in Illinois, Indiana, and Kentucky, and possibly in stretches of the upper Mississippi River adjacent to Missouri (U.S. Fish and Wildlife Service 1989, Cummings et al. 1990). The most significant remaining population of *P. capax* resides in ditch tributaries of the St. Francis River in northeast Arkansas and southeast Missouri (Jenkinson and Alstedt 1993-1994, Roberts et al. 1997).

An environmental survey reported *P. capax* in the project area from Fish Lake Ditch at Hwy 80, just northeast of the Ten Mile Pond Conservation Area (CA) (Environmental Science and Engineering, Inc., (ESEI) 1978), however, no voucher specimens were provided. A 1980 survey of Fish Lake Ditch by Alan Buchanan, MDC, failed to find this species. He believed the mussel reported by ESEI to be *P. capax* was actually mistaken for *L. ventricosa (=cardium)*, a similar species. The most comprehensive mussel survey of the St. Johns and New Madrid basins did not find any evidence of this species (Barnhart 1998). However, many of the ditches in the project area may be suitable habitat (Brian Obermeyer, Kansas Wildlife and Parks, pers. comm.).

Federal Candidate Species

Two candidate fish species, the sicklefin chub and sturgeon chub, occur in the main channel of the Mississippi River in the project area. The chubs are small, native river cyprinids which are currently being considered for federal listing as threatened or endangered. Both those fish occur along and over sandbars in main channel border areas and chutes between the mainland and sandbar islands. Typically, they are found over sand and gravel substrate and in current velocities of 0-1.3 feet-per-second. The reformulated project will not affect habitat for these species.

Public Lands

The MDC manages two conservation areas in the project area. The Ten Mile Pond CA covers 3,793 acres of cropland, wetlands and forest. It is located in the Floodway along an old oxbow lake formed when the Mississippi River meandered over that section of floodplain. The ditches, ponds and lake on the CA provide significant opportunities for anglers. That area also provides opportunities for small and big game hunting, as well as waterfowl. The Donaldson Point CA lies largely outside the frontline levee along the Floodway. That 5,785-acre area is mostly BLH forest. Bald eagles have been known to nest there.

Big Oak Tree State Park is managed by the Missouri Department of Natural Resources. It includes approximately 1,000 acres of rare swamp and BLH forest. Because it is one of the few remaining forested wetlands in southeast Missouri, it serves as a refugia for many increasingly rare species and contributes significantly to the biodiversity of the region. The Park claims two national and three state champion trees. Several State-listed rare plant and animal species have also been recorded in the Park.

Floodplain Ecology

The St. Johns Bayou basin and the New Madrid Floodway were originally part of the historic Mississippi River floodplain, and although highly altered, still perform floodplain functions critical to nationally significant fish and wildlife resources. As previously mentioned, the Floodway, in particular, is still largely connected to the Mississippi River which annually inundates much of the lower study area, providing an important exchange between terrestrial habitats and the aquatic system. Such flood pulses have been called "the principal driving force(s) for the existence, productivity, and interactions of the major biota in river-floodplain systems..."(Junk et al. 1989). Not only do flood waters rejuvenate aquatic habitats (e.g., bayous, oxbows, sloughs, ditches, ponds and wetlands) on the floodplain, they also provide access to the floodplain's productivity which is far greater than that of the river main stem (Junk et al. 1989, Guillory 1979). Much of that productivity is organic detritus (e.g., leaves, grasses, etc.), however invertebrate levels are also significant. Eckblad et al. (1984) found the number of macroinvertebrates drifting from an upper Mississippi River backwater was three to eight times higher than in the main channel upstream of the backwater. Hrabik (1994) notes that floodplain production is high relative to the other macrohabitats based on estimated zooplankton densities and biological oxygen demand rates. In 1993, zooplankton density was 500 times greater in the wide versus the moderately-wide floodplain near Cape Girardeau (Hrabik 1994). That productivity in turn supports the fisheries and other aquatic resources of the river proper (Junk et al. 1989, Amoros 1991, Lambou 1990, Welcomme 1979). Based on post-flood studies on the Missouri River, Galat et al. (1998) noted that river flooding can facilitate zooplankton colonization of floodplain habitats as documented by higher cumulative species richness in scour holes that were continuously or periodically connected to the river than scour holes with no such connection.

The variability of natural flooding regimes and associated ecologic processes, both within and among years, creates and maintains diverse habitats and differential species success that supports the greatest biodiversity (Poff et al. 1997, Galat et al. 1998). Because of Mississippi River flooding, the study-area floodplain provides diverse habitats essential for spawning, rearing, foraging, and refuge to numerous aquatic species. Fishes that seasonally use the floodplain dominate the fisheries, biomass, and production in river-floodplain systems (Junk et al. 1989). Approximately half of the fish species of the lower Mississippi River use the floodplain as a nursery (Gallagher 1979). In most years, rising river levels inundate the floodplain in the spring, while rising temperatures and increased photoperiod trigger spawning in numerous fish species. In their work on a southern BLH forest along the Tallahatchie river, Turner et al. (1994) collected more larval and juvenile fish from the floodplain than from the adjacent river, consistent with several other studies. Unlike the main stem of the river, the floodplain is characterized by slackwaters, beds of aquatic vegetation, and organically rich substrates (Guillory 1979, Rissoto and Turner 1985), important habitat for fish spawning and rearing. Those areas often have aquatic vegetation, snags, and logs that also provide refuge from predators (Killgore and Hoover 1998).

Other wildlife also benefit from spring floods. Many species of amphibians throughout the project area require shallow waters to successfully reproduce. In addition to permanent ponds, sloughs, and ditches, spring flooding can cover up to 75,000 acres in the New Madrid Floodway alone. As those waters recede, they create thousands of ephemeral ponds critical to maintaining a healthy and diverse amphibian population. Habitats with variable flooding regimes have been shown to support highly divers herptofauna. Work by Galat et al. (1998) documented differential use and abundance of reptiles and amphibians in a variety of wetland types. For example, connected scours were dominated by false map turtles and softshells; remnant wetlands had more sliders and painted and snapping turtles. Scour holes contained to the river contained the highest species richness. Remnant wetlands had the more species of salamanders and snakes than other types of wetlands. Those various wetland types also supported a diverse bird assemblage, where species use of a particular type of wetlands appeared to depend on wetland size, structural diversity, and depth. In addition, flooding increases invertebrate biomass, which then becomes an important protein source for waterfowl and shorebirds on their migration to northern breeding grounds (Helmers 1992, Reinecke et al. 1989).

Mississippi and New Madrid counties, including the project area, support more diverse habitats and natural communities than elsewhere in the Bootheel. That increased diversity is reflected in the number of State-listed plant, mussel, fish, amphibian, reptile, bird, mammal, and natural communities reported for the two-county area (Table 2) and is due in part to the influence of the river's annual hydrologic regime on the lower St. Johns Bayou basin and New Madrid Floodway. Although greatly altered, the project area still functions as an integral part of the Mississippi River ecosystem, and provides important breeding, migration and overwintering habitat for numerous species. The forested wetlands in the project area, a small remnant of a once extensive forest complex, are becoming increasingly scarce. At the same time, they become more and more critical as refugia to numerous species that once flourished on the floodplain. In spite of numerous modifications, the varied habitats within the project area contribute significantly to the State's biodiversity and the ecological integrity of the lower Mississippi River.

Fish and Wildlife Concerns and Planning Objectives

Historically, the Mississippi River Alluvial Valley floodplain was the largest bottomland forested wetland in North America covering approximately 2.5 million acres. Most of that area was subject to periodic flooding by the Mississippi River, providing invaluable habitat for fish and wildlife. Since the early 1700s, however, channelization and levee construction have reduced the natural floodplain of the lower Mississippi River by 90 percent (Fremling et al. 1989). Most of the forested wetlands have been converted to cropland. Private and publicly funded flood control and drainage projects have drastically changed the hydrologic relationship between the floodplain and the river, essentially eliminating seasonal interchange. Baker et al. (1991) have called the reduction of seasonally inundated floodplain due to levee construction the single most

Table 2. State-listed rare and endangered species in New Madrid and Mississippi counties

Plants	Mississippi	New Madrid
Gourd (*Cayaponia grandifolia*)	S1	
Juniper leaf (*Polypremum procumbens*)	S2	S2
Trepocarpus (*Trepocarpus aethusae*)	S1	
Primrose willow (*Ludwigia leptocarpa*)	S2	
Yellow false mallow (*Malvastrum hispidum*)	S3	
Arrow arum (*Peltandra virginica*)	S2	
American frogbit (*Limnobium spongia*)	S2	
American cupsale (*Sacciolepis striata*)	S1	
Swamp loosestrife (*Decondon verticillatus*)	S1	
Bristly sedge (*Carex comosa*)	S2	
Sedge (*Carex socialis*)	S2	
Corydalis (*Corydalis micrantha*)		S2
Leatherflower (*Clematis viorna*)		S1
Finger dog-shade (*Cynosciadium digitatum*)		S2
Weak nettle (*Urtica chamaedryoides*)	S1	S1
Narrow-leaved wild crabapple (*Malus augustifolia*)		S1
Eastern blue-eyed grass (*Sisyrinchium atlanticum*)	S2	S2
An umbrella sedge (*Cyperus retroflexus*)	S1	
An umbrella sedge (*Cyperus grayoidies*)		S2
Many-spiked cyperus (*Cyperus polystachos*)		S2
Baldwin's cyperus (*Cyperus croceus*)		S1
Mussels		
Rock pocketbook (*Aricidens confragosus*)	S3	S3
Wartyback (*Quadrula nodulata*)	S3	S3
Flatfloater (*Anodenta suberbiculata*)	S2	S3
Texas lillput (*Toxolasma texasensis*)	S3	S3
Fish		
Harlequin darter (*Etheostoma histrio*)	(E)S2	
Flier (*Centrarchus macropterus*)	S3	

E - State listed endangered X- communities no longer ranked

Rank:

S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).

S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).

S3 - Rare and uncommon in the state (21 to 100 occurrences).

Table 2 (cont'd.). State-listed rare and endangered species in New Madrid and Mississippi counties

	Mississippi	New Madrid
Fish		
Ironcolor shiner (*Notropis chalybaeus*)	S1	S1
Mississippi silvery minnow (*Hybognathus nuchalis*)	S3	
Pallid sturgeon (*Scaphirynchus albus*)	(E)S1	
River darter (*Percina shumardi*)	S3	
Blue sucker (*Cycleptus elongatus*)		S3
Lake chubsucker (*Erimyzon sucette*)	S2	S2
Brown bullhead (*Ameiurus nebulosus*)		S3
Mooneye (*Hiodon tergisus*)	R	S2
Paddlefish (*Polydon spathula*)	S3	
Sicklefin chub (*Macrhybopsis meeki*)	S3	
Golden topminnow (*Fundulus chrysotus*)	S1	
Reptiles and Amphibians		
Illinois chorus frog (*Pseudacris streckeri illinoensis*)	S2	S2
Western chicken turtle (*Deirochelys recticularia miaria*)	(E)S1	
Eastern spadefoot (*Scaphiopus holbrookii*)	S2	
Alligator snapping turtle (*Macroclemys temminckii*)	S2	S2
Birds		
Bald eagle (*Haliaeetus leucocephalus*)	(E)S2	(E)S2
Mississippi kite (*Ictinia mississippiensis*)	S2	S2
Pied-billed grebe (*Podilymbus podiceps*)	S2	S2
Interior least tern	(E)S1	(E)S1
Barn owl (*Tyto alba*)	(E)S2	(E)S2
Swainson's warbler (*Limnothlypis swainsonii*)		(E)S1
Little blue heron (*Egretta caerulea*)	(S2)	
Snowy egret (*Egretta thula*)	(S1)	
Mammals		
Swamp rabbit (*Sylvilagus aquaticus*)	S2	S2
Cotton mouse (*Peromyscus gossypinus*)		S2
Communities		
Wet Bottomland Forest	X	X
Swamp	X	X
Shrub swamp	X	

Source: MDC (1997 and 1999), Carter and Bryson (1991), Barnhart (1998), MDNR (1997) deleterious alteration to the lower Mississippi River. Today, drainage ditches are the principal remaining aquatic habitat in much of the Bootheel (Pflieger 1997).

The above alterations to the Mississippi River floodplain have been accompanied by marked declines in both the abundance and diversity of fisheries and wildlife of the region. Many once-common species are becoming scarce and several are Federally listed as endangered or threatened. Most of the remaining unique flora, fauna, and natural communities in the project area are associated with the wetlands that still remain in portions of the St. Johns Bayou basin and the Floodway. Those wetlands, however, will lose most their wetland functions, and will be more likely converted to agriculture once they are no longer subject to backwater flooding.

In recognition of the critical functions wetlands provide to fish, wildlife, and humans (e.g., improve water quality, store storm water, reduce flood stages, etc.), Congress has enacted legislation (i.e., Clean Water Act) to protect remaining wetlands and to reverse historic wetland losses (e.g., 1985 and 1990 Farm Bills; Emergency Wetlands Protection Act of 1986; Water Resources Development Acts of 1986, 1992, and 1996; Agriculture Credit Act of 1987; Conservation Reserve Program; Food Security Act of 1992; Wetlands Reserve Program (WRP); and Federal Agriculture Improvement and Reform Act of 1996). Approximately 1,024 acres within the project area are enrolled in the WRP.

The National Research Council (1992) noted that the cornerstone of modern floodplain restoration and integrated floodplain management rests on the understanding that "rivers and their floodplains are so intimately linked that they should be understood, managed, and restored as integral parts of a single system." To underscore the importance of floodplains as an integral part of the river ecosystem, Executive Order 11988 on floodplain management states that Federal agencies should avoid undertaking actions that directly or indirectly adversely affect natural floodplain functions and values. Furthermore, the President's Clean Water Initiative has a goal of gaining 100,000 acres of wetlands annually by the year 2005. Clearly, the above authorities direct agencies to take advantage of every opportunity to protect, improve and restore wetland habitat in the study area and enhance regional fish and wildlife resources.

To address the previously noted problems and ensure that fish and wildlife resources receive equal consideration with other project purposes, the Service and MDC developed the following planning objectives to be incorporated into the St. Johns Bayou and New Madrid Floodway Project:

1. Avoid and/or minimize adverse impacts on fish and wildlife resources by minimizing negative impacts to marshes, forested wetlands and aquatic habitats in the project area, and ensuring fisheries access to the Floodway during spring for spawning and nursery habitat.;

2. Incorporate the goals of the North American Waterfowl Management Plan and other Administration wetland-related initiatives in project planning;

3. Provide compensatory mitigation to fully offset unavoidable project-related losses of wetlands and aquatic habitat in the study area.

Evaluation Methodology

Estimation of project-related habitat changes is a fundamental technique used to assess project impacts to fish and wildlife resources. Those estimates also form the basis of other evaluations conducted by the Corps. For this project, we quantified habitat changes associated with the project construction rights-of-way (ROWs) for the levee closure and channel enlargement, and hydrologic changes from pump operations.

As part of an interagency team that included the Corps and MDC, the Service used several tools to evaluate project-related changes in the quantity and quality of habitat for fish and wildlife. Most of those tools are based on the Habitat Evaluation Procedures (HEP) (USFWS 1980). HEP is a method of estimating habitat suitability for evaluation species based on field measurements of parameters that limit the relative population density of a selected species. Using HEP (and similar tools), habitat quantity and quality can be measured for baseline conditions, and can be predicted for future without-project and future with-project conditions. The standardized, species-based method numerically compares future with-project and future-without project conditions to provide an estimate of project impacts on fish and wildlife resources. Further details on specific analyses are in Appendices B through E.

The Memphis District Corps of Engineers used a Geographic Information System to determine acreage of various land cover types within the study area based on satellite imagery. Those cover types and acreage were used to determine available habitat for the HEP analyses. The Corps then used stage area curves to determine the acreage that is inundated at least 5 percent of the growing season (approximately 12 days); those areas are considered wetlands. The Corps used changes in the stage area curves for each alternative to determine changes in wetland acreage. The Corps also used the stage area curves to determine acreage suitable for waterfowl and shorebirds (Appendices B and D).

Fish and Wildlife Resources Without the Project

Fish and wildlife resource conditions in the project area are unlikely to change appreciably without project implementation. Existing wetland protection should minimize conversion of small wetlands to other uses. Some additional landowners may even take advantage of several wetland programs that offer financial incentives to restore or improve wetlands on their property. Mature forested wetlands, such as in Big Oak Tree State Park, will continue to degrade (e.g., no regeneration) from previous hydrologic alterations unless water control programs are implemented to restore historic water levels. Forested wetlands along the lower reaches of St Johns Bayou may change to include species with greater water tolerance (e.g., cypress, buttonbush, etc.), responding to the high water levels when the St. Johns gravity drainage structure is closed.

Fisheries resources will continue to have access to the Floodway ensuring nursery and spawning habitat and refugia, as well as contributing to the productivity of the river system. Project area ditches will be disturbed periodically during channel maintenance. Those events, however, generally occur over small reaches, several years apart, allowing the much of the ditch biota to recolonize the affected area. Both waterfowl and shorebirds will continue to benefit from seasonal flooding in the project area during spring migration. Tens of thousands of acres of permanent, seasonal and ephemeral ponding will help meet the life requirements of numerous reptiles and amphibians.

Description of the Proposed Alternatives

The Authorized Project alternative includes vegetative clearing along 4.3 miles (which has been conducted under a separate review) and enlarging 23.4 miles of rural channels in the St. Johns basin. The improved channel would be 200 feet wide along the lower St. Johns Bayou to the Setback Levee Ditch where it would narrow to 50 feet. The lower 3.5-miles of the St. James ditch will become 45 feet wide and the top bank along northern most reach (7.8 miles) will be widened to 100 feet. The project also includes a 1,000-cfs pump station near the existing gravity drainage outlet to accommodate the increased runoff. In the New Madrid Floodway, the Crops would construct a 1,500-cfs pump station in conjunction with a separately authorized levee closure and drainage structure at the southern end of the Floodway.

In addition to the authorized project, the Corps is also evaluating an Avoid and Minimize (A&M) alternative. Under the A&M alternative, channel widening in St. Johns Bayou would be reduced from 200 to 120 feet wide; bank work along the St. James Ditch would be restricted to one side of the channel to minimize impacts to riparian corridors; and pump operations would allow higher spring water levels in the St. Johns basin and the Floodway (i.e., pumping would stop at 282 and 280 NGVD versus 277 and 275 NGVD).

Project Impacts

Wetlands

Implementation of the either the Authorized or the A&M alternative would greatly alter the hydrologic regime of ten of thousands of acres of wetlands (Table 3). According to the Corps, approximately 36,480 acres of wetlands would no longer be seasonally inundated by backwater flooding under the Authorized Project alternative. Under the A&M alternative, approximately 36,000 acres would no longer be seasonally flooded. In the St. Johns Bayou basin, both alternatives would decrease the acreage of existing forested wetlands receiving riverine backwater flooding by approximately 27 percent. In the New Madrid Floodway, implementing

Table 3. Wetland acreage affected under the Authorized Project and the A&M alternatives.

St. Johns Bayou Basin

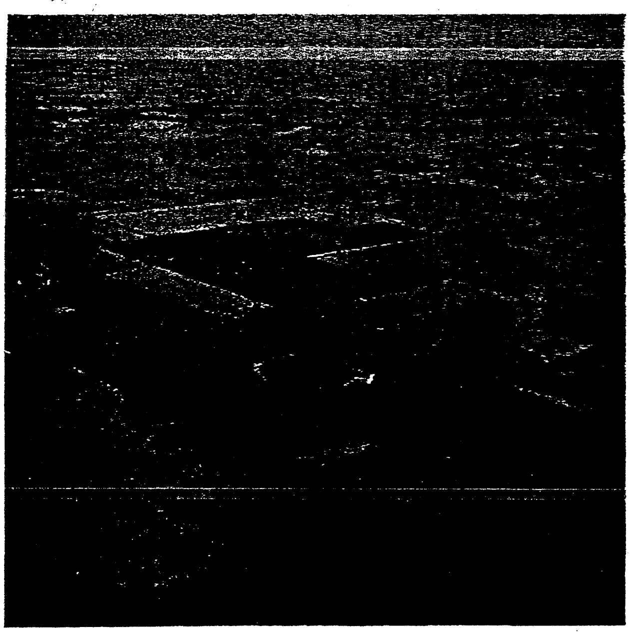
Land Use	Total Wetland Acres	Wetland Acres 300 and below	Authorized Acres	Authorized Percent total wetland acres	Avoid & Minimize Acres	Avoid & Minimize Percent total wetland acres
Forested	4,473.26	3,163.58	592.41	13.24	564.97	12.63
Scrub/Shrub/Marsh	12.54	4.14	1.11	8.85	1.11	8.85
Cropland	22,998.61	9,303.23	5,632.87	24.49	5,633.25	24.49
Pasture	135.23	75.87	19.26	14.24	19.36	14.32
Herbaceous	2,044.96	719.26	294.85	14.42	294.58	14.41
Open Water	944.24	286.97	169.02	17.90	166.28	17.61
Sandbar	11.47		-	-	-	-
Urban	1.96		-	-	-	-
Total	**30,622.27**	**13,553.05**	**6,709.52**	**21.91**	**6,679.55**	**21.81**

New Madrid Floodway

Land Use	Total Wetland Acres	Wetland Acres 300 and below	Authorized Acres	Authorized Percent total wetland acres	Avoid & Minimize Acres	Avoid & Minimize Percent total wetland acres
Forested	5,734.30	5,402.64	5,329.81	92.95	5,137.55	89.59
Scrub/Shrub/Marsh	193.62	139.17	139.1	71.84	138.14	71.34
Cropland	27,903.54	21,922.54	21,900.53	78.49	21,791.64	78.1
Pasture	205.78	140.9	139.53	67.8	135.59	65.89
Herbaceous	1,938.64	1,578.51	1,572.07	81.09	1,550.92	80
Open Water	797.29	691.4	689.16	97.5	622.37	87.63
Sandbar	0.33	-	-	-	-	-
Urban	-	-	-	-	-	-
Total	**36,773.50**	**29,875.16**	**29,770.20**	**81.14**	**29,376.21**	**80.07**

either alternative would reduce forested wetlands flooded by backwater by 90 percent. The Floodway would also have an 80 percent decrease in herbaceous wetland acreage affected by riverine flooding. Such changes in the hydrology of those wetlands would greatly diminish, and in some cases eliminate, their contribution to the riverine ecosystem. Those remaining wetlands not dependent on backwater flooding would become isolated, depressional systems. Wharton et al. (1982) noted that the productivity and ecologic value of forested wetlands depend on the "...primary driving force, the fluctuating water levels of the riverine system." As previously mentioned, the New Madrid Floodway currently is the only tributary floodplain still connected to the Mississippi River in Missouri. Implementation of either project alternative would sever that connection, essentially decoupling the floodplain from the river.

Project-related hydrologic changes would also lead to widespread dewatering of the remaining wetlands. Currently, 10,208 acres of forested wetlands occur in the project area. Some of the largest unprotected, contiguous stands of bottomland hardwood forests remaining in southeast Missouri occur in the lower St. Johns Bayou basin and will be most affected by project implementation. Under existing conditions, forested wetlands account for approximately 7.2 and 5.8 percent of the wetlands in the area below 300 feet NGVD (the area to be affected by either alternative). That figure includes public land, timber company land, and WRP land.



Although the remaining wetland areas are characterized by very heavy soils and a high water table, the same is true for much of the cropland in the project area. Overlaying the Corps' landcover data on the wetland map shows that most of the remaining undeveloped wetlands, particularly forested wetlands, correspond most closely to property lines and drainage networks, not the underlying soils. In many cases, modifications to the project area's natural hydrology and land owner practices have a greater effect on the distribution of wetlands than does the presence of hydric soils (Figure 3).

Figure 3. Big Oak Tree State Park

Although the Mississippi River seasonally recharges the groundwater in the eastern portions of the project area, the interaction between surface water, groundwater and river seepage is poorly understood (U.S.G.S., per. comm.). Currently, the Corps is working on several seepage control features in the Floodway as part of the Mississippi River Mainline Levee enlargement that will further modify water patterns in the project area. In addition, the cropping patterns in areas previously subject to backwater flooding are likely to emphasize more profitable crops and increase the use of irrigation, increasing surface and groundwater demands. Both project alternatives would lower portions of the Setback Levee Ditch and the St. James Ditches by 5 feet. In a study of the effects of channelization on forested wetlands, Maki et al. (1980) noted that outside of seasonal effects, the greatest differences in ground water levels were caused by channel modification. They noted that deepened channels intercepted the groundwater table and depleted soil moisture in adjacent bottomlands. The water table in channelized basins remained at least 1.3 feet below the level found in natural watersheds regardless of land use. Luckey (1985) also found a similar pattern in southeast Missouri; namely that enhanced drainage lowers the groundwater levels in the soil. Maki et al. (1980) further noted that channelization not only reduces the amount of ponding on floodplains, but shortens ponding duration. During spring, summer, and fall, evapotranspiration demands can effectively eliminate surface ponding.

In light of the above factors, it is extremely to predict with certainty post-project surface water patterns in either basin. Under either project alternative, however, spring water levels will be significantly lower than existing conditions. The Corps believes that there will be no indirect project-related changes in jurisdictional wetlands because they anticipate that rainfall and groundwater seepage will maintain saturated soils in the existing wetlands sufficient to meet the wetland criteria. However, widespread changes in the hydrology of existing farmed wetlands, from pre-project inundation to post-project saturation, would have significant implications under the Food Security Act (FSA). The FSA stipulates that farmed wetlands must have a 50 percent chance of being seasonally ponded or flooded at least 15 days during or 10 percent of the growing season, whichever is less. Although the USDA, Natural Resources Conservation Service (NRCS), has previously called many of the farmed wetlands in the project area prior converted wetlands, recent discussions with NRCS (Pat Graham, pers. comm.) indicate that the mapping protocols used for those uncertified determinations were very limited, and that using current wetland protocols would show far more wetlands in the same area. A 1997 interagency review of those previous determinations, signed by NRCS, the Corps, EPA and the Service, showed that zero percent of those determination were found to be "... of sufficient quality for implementation of wetland conservation provisions of the Food Security Act and for purposes of implementing section 404 of the Clean Water Act."(See attached). Based on the Corps' modeling results, project-related hydrologic changes may remove inundation on up to 20,000 acres of farmed wetlands in the Floodway alone. Without surface-water flooding or ponding during the growing season, those acres would no longer meet the wetland criteria under the FSA. The Service believes such conversion would possibly violate the "Swampbuster" provisions of the FSA, which in turn could affect project sponsors who participate in Federal agricultural programs.

Swampbuster has been an effective mechanism to greatly reduce wetlands conversion associated with agricultural development. In fact, the Corps believes that Swampbuster regulations will reduce or prevent future wetlands conversion in the project area. Under the 1996 Federal Agricultural Improvement and Reform Act, however, current farm program payments (which play a large role in Swampbuster) are scheduled to end in 2002. After that time, there will be no financial disincentives for agricultural conversion of wetlands. In a recent publication the USDA (Heimlich et al.1998) summarized what they believe will happen if those payments are phased out:

"... in the short run, 5.8 to 13.2 million acres [of wetlands] would be profitable to convert to agricultural production based on expected prices, increasing income for those farmers with wetlands to convert. In the long run, some marginal cropland would drop out of production, leaving a net cropland addition of 2.2 to 5.0 million acres. Increased commodity supplies from the added acreage would depress commodity prices for all farmers, resulting in reductions of farm income of $1.6 to $3.2 billion."

Furthermore, project implementation will replace a naturally-variable flooding regime with a well-regulated, fairly predictable flooding pattern. The level of risk to farmers who chose to crop previously marginal areas is greatly lowered. Considering the changes in future surface-water levels throughout the project area, reasonably foreseeable modifications to the project area's drainage patterns, existing land practices, and the USDA projections of future wetland conversion to agriculture, the Service believes most of the privately-owned forested wetlands no longer subject to backwater and overland flooding will face greater development pressure and likely will be converted to agriculture use.

Project implementation would not only reduce riverine flooding in both basins, but it would also significantly alter the temporal and spatial variability of that flooding. As proposed, pumping operations in the St. Johns Bayou basin and the New Madrid Floodway would replace a natural, highly variable flooding regime with a flooding pattern that would be the same each year; higher water levels (i.e., + 11 to 17 feet) in the winter, and lower water levels (i.e., - 4 to 8 feet) throughout much of the spring. This will eliminate years of high waters levels that infrequently rejuvenate higher elevation marshes, forested wetlands, and riparian areas. Based on the Corps' hydrologic analyses, the proposed alternatives would eliminate such flooding on 1,574 acres of forested tracts in the St. Johns Bayou basin, and 6,577 acres in the New Madrid Floodway. In addition, the proposed pumping operations will maintain artificially high winter water levels in the lower portions of both basins, further stressing the forested wetlands in those areas.

In their treatise on greentree reservoir management, Fredrickson and Batema (1992) underscore the importance of fluctuating water regimes to the maintenance of high productivity in forested wetlands. They noted several characteristic flooding patterns in unaltered forested wetlands that should be emulated in managed systems. Those include ensuring flooding after trees break dormancy in the spring; minimizing flooding that overtops red oak species during the dormant season that could lead to high mortality and prevent regeneration; and ensuring hydrologic variability within and among years (Fredrickson and Batema 1992). Neither of the proposed pumping operational alternatives incorporate those measures. Consequently, we believe those few forested wetlands remaining after project implementation may progressively degrade.

Floodplain wetlands provide an extremely important function at a landscape-level. Their capacity to store flood waters can greatly reduce river stages downstream (Taylor et al. 1990). In fact, cumulative losses of floodplain storage capacity in the Mississippi River Valley have led to increased flood stages in the lower river (U.S. Army Corps of Engineers 1998). Those higher stages, in turn, lead to additional flood control projects (e.g., levee enlargements) to protect lives, property, and existing infrastructure. The Corps, recognizing the importance of that storage capacity, has designated certain floodplains along the lower river valley as "floodways." Those floodways are integral components of the Mississippi River and Tributaries Project. For example, the New Madrid Floodway was constructed to lower stages in Cairo, IL and Paducah, KY during a project flood. The proposed levee closure at the mouth of the Floodway would further decrease the available floodplain storage capacity along the lower river during river stages lower than a "project flood" (when the Corps would operate the Floodway), possibly affecting flood stages along this reach of the Mississippi River.

Wildlife Resources

Project-related impacts that have been quantified to date include changes in: winter carrying capacity for waterfowl (Appendix B), habitat value for forest wildlife (Appendix C) and foraging habitat for migratory shorebirds (Appendix D). Effects on other wildlife (e.g., reptiles and amphibians, wading birds), although not quantified, will be discussed qualitatively.

Implementation of the proposed project alternatives would greatly alter the habitat available for wintering and migrating waterfowl. One negative impact will be the loss of flooding diversity. Flood timing, duration, and depth will be controlled through pump operations, removing natural variability which contributes to the overall health and stability of wetland ecosystems. The Waterfowl Assessment Methodology (WAM) was used to quantify changes in the potential carrying capacity (i.e., food) for wintering and spring migrating waterfowl in the project area. WAM results indicate that the Authorized Project and the A&M alternatives would potentially produce an increase in duck-use days (DUDs) in December and January, while reducing DUDs in February and March. In the St. Johns Bayou basin, the Authorized Project alternative would potentially increase winter DUDs by 464,906 but reduce waterfowl habitat by 74,390 DUDs in February and March, during spring migration. WAM results for the A&M alternative in that basin show a similar winter increase, primarily because of increased moist soil and soybean acreage. That alternative would provide important habitat during spring migration by inundating forested wetlands. In the New Madrid Floodway, the Authorized Project would potentially increase the winter DUDs by 50,140 while reducing February and March usage by 225,822 DUDs; a pattern similar to that seen in the St. Johns basin. WAM results for the A&M alternative show a similar winter increase, and a significant decrease in spring usage by 222,588 DUDs. Under both those alternatives, moist soil and BLH forest acreage flooded during spring migration would be significantly lower, reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988).

Increased DUDs indicated by WAM during December and January for both basins are the result of ponding in the sump as specified by the operational plan. Those potential gains, however, are very questionable. Traditional use of wintering waterfowl habitats in southeast Missouri is closely linked to the relative wetness (i.e., rainfall) within the regions during late October through January (Bellrose and Crompton 1970, Nichols et al. 1983). Forty-nine hundred acres of ponded water in an otherwise dry St. Johns basin and New Madrid Floodway is an relatively small tract of habitat to migrating waterfowl. For example, over the last several years, the Eagles Nest Wetland Reserve Program tract and rice fields on Hunter Farms have been annually flooded using pumps during fall and winter for hunting. Those habitats, however, receive significantly less waterfowl use in dry years than in years when the region is wet (D. Wissehr and B. Allen, MDC, pers. comm.). Under the proposed alternatives, bottomland hardwoods in the sump area would be flooded annually to great depths for extended periods. Such inundation is detrimental to bottomland hardwood species (Fredrickson and Batema 1992) and could undermine their long-term survival. In light of the above, we strongly recommend that the operational plan be altered to allow for the greatest possible diversity of flood timing, duration, and depth November through March. We believe such a plan would realize more benefits to waterfowl, as well as other species. Altering the operational plan would also allow the river to ebb and flow into both basins during that time, greatly benefitting fisheries resources by maintaining connectivity between the river and its floodplain.

It is important to note that WAM does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, pers. comm.). Furthermore, the WAM does not consider other forested wetland habitat components necessary for healthy waterfowl populations. During spring migration, waterfowl are forming pairs, molting, and preparing to breed (Heitmeyer 1985). Forested wetlands fulfill special seasonal waterfowl habitat requirements not found in open land (i.e., moist soil areas and farmed wetlands). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Both project alternatives would eliminate backwater flooding on thousands of acres of forested wetlands and moist soil areas during spring migration, significantly reducing habitat that provides necessary protein sources particularly important to waterfowl at that time of year. Under existing conditions, those waterfowl acres occur during spring flooding and are distributed over up to 75,000 acres. Large flooded areas such as those are critical for waterfowl, especially as they form breeding pairs. Because of the differing seasonal habitat requirements of waterfowl, potential fall migration and winter habitat benefits cannot replace significant spring migration habitat losses that would occur with either project alternative.

The proposed project alternatives would also negatively affect forested wetland habitat value for wildlife. Results of the HEP analyses of direct habitat losses attributable to levee construction and channel enlargement are summarized on Table 4. Channel enlargement will include clearing portions the riparian corridor within the channel work rights-of-way and, in some reaches, removing the banks to enlarge the channel. A narrow berm would be constructed adjacent to the new channel, seeded and periodically maintained. An elevated spoil area would be located landslide of the berm. The direct impacts in Table 4 assume that a protective easement will be placed over the construction rights-of-way for channel work in the St. Johns basin and the levee closure in the Floodway, and that berm maintenance along the enlarged ditches will be minimal, allowing all rights-of-way to revegetate naturally. Levee construction will directly affect only a small acreage of forested wetlands in the Floodway.

Table 4. Direct forested wetland habitat losses from levee construction and channel enlargement (expressed in average annual habitat units).

Species	St. Johns basin Author.	St. Johns basin A&M	New Madrid Floodway Author./A&M
Barred owl	677.81	488.82	15.22
Fox squirrel	386.57	281.54	11.49
Pileated woodpecker	547.44	393.23	12.56
Carolina chickadee	714.33	514.83	15.43
Mink	428.21	314.13	11.28
Total	2754.37	1992.55	65.98

The indirect effects of the proposed alternatives will be far greater, particularly in the Floodway. As previously mentioned, the Service believes implementation of either project alternative will lead to conversion of significant tracts of forested wetlands that are no longer subject to backwater flooding. Based on historic and existing land use patterns, and the enhanced drainage system throughout the project area, the HEP team originally predicted that approximately 90 percent of privately owned forested wetlands no longer subject to riverine flooding (because of the project) would be converted to another land use over the 50-year project life. That acreage excluded lands enrolled in WRP and timber company property that will be managed as forested habitat. Table 5 summarizes the habitat losses associated with converting existing forested

Table 5. Indirect forested wetland habitat losses from reduced backwater flooding. (expressed in average annual habitat units).

Species	St. Johns basin Author/A&M.	New Madrid Floodway Author.	New Madrid Floodway A&M
Barred owl	645.85	1,714.75	1,642.37
Fox squirrel	613.35	1,349.50	1,292.53
Pileated woodpecker	512.68	1,498.32	1,436.41
Carolina chickadee	661.04	1,717.50	1,645.00
Mink	390.01	216.45	200.85
Total	2,822.93	6,496.52	6,217.16

wetlands to cropland. All wildlife evaluation species showed significant losses in habitat values due to induced wetland impacts. In addition to impacts that can be quantified through HEP analyses, wildlife using the remaining forested tracts will also be negatively affected by increasing forest fragmentation which is particularly detrimental to certain neotropical migratory bird species (Robbins et al 1989, Askins et al. 1990). Fragmentation can lead to higher rates of nest parasitism and competition from birds species that prefer edge habitat.

Three species (i.e., muskrat, red-winged blackbird, and great blue heron) were used to evaluate project-related changes in marsh habitat values. Most of the marsh in the study area is found in the New Madrid Floodway, primarily along borrow pits. The HEP team assumed those acres would remain the same because those areas should receive enough rainfall and runoff to maintain marsh vegetation. Based on that assumption, HEP results indicate that project-related changes in marsh habitat values will be insignificant.

To quantify project-related changes in shorebird migration habitat value, a HEP-based model was developed by a small workgroup (Appendix C). Shorebird habitat is considered that area within one foot of the 50 percent flood exceedence elevation for the months of April and May (the months of peak shorebird use in the project area), and non-forested wetlands, wet croplands, and rice fields above the 50 percent exceedence elevation. Implementation of either project alternative would significantly reduce shorebird migration habitat value in both basins (Table 6).

Table 6. Project-related losses of shorebird habitat values during April and May. (Expressed in average annual habitat units).

	Author. Proj.	% net change	A&M	% net change
St. Johns Bayou basin	119.17	-30.8	104.42	-27.0
New Madrid Floodway	672.28	-69.9	656.78	-56.5
Total study area	791.45	-58.7	761.2	-56.5

The A&M alternative, however, would prevent some of the losses anticipated under the Authorized Project alternative in the St. Johns Bayou basin by allowing an 1.5 feet increase in water levels before pumping begins during April and May. In the New Madrid Floodway, either alternative would reduce shorebird habitat value between 56 and 70 percent. Both the Authorized Project and the A&M alternatives would greatly lower water levels in April and May (up to eight feet), virtually eliminating suitable shorebird habitat acreage in the years following project completion. Moreover, after 50 years, suitable habitat will still only be 4.5 percent of that provided under future without-project conditions. The HEP team assumed that cropping patterns under future with-project conditions would include increasing rice acreage; that assumption accounts for the majority of shorebird habitat value under both project alternatives. It is important to note that the shorebird HEP analyses address only spring migration habitat. In years when high river stages occur in June and July (e.g., 1993, 1995, 1996, 1997), backwater flooding and the thousands of acres of ephemeral ponds left behind provide important habitat for shorebirds which begin migrating south in late July and early August.

Project implementation is also expected to negatively affect reptiles and amphibians in the project area. Eliminating seasonal backwater flooding over thousands of acres, and the ephemeral ponds that remain after flood waters recede will significantly reduce suitable habitat for reptiles and amphibians, particularly during spring breeding. In addition, project-related changes to surface water patterns may eliminate ponding in many areas in all but the wettest years. This would not only reduce available habitat, but further fragment and isolate tracts of remaining habitat and their reptile and amphibian populations.

Aquatic Resources

The most significant project impact to aquatic resources is the loss of seasonal flooding in the St. Johns and New Madrid basins. Under the Authorized Project alternative, the levee closure and pumping operations will eliminate Mississippi River backwaters from entering the New Madrid Floodway and significantly reduce interior flooding in both basins. That, in turn, reduces spawning and rearing habitat for river and floodplain fishes. Killgore and Hoover (1998) used HEP procedures to quantify project-related reductions in flooding on fish spawning and rearing habitat in both basins (Appendix D). *The analyses did not assess the effects of the levee closure on fisheries access to the floodway.* On average, rearing habitat in the St. Johns Bayou basin will be reduced from 3,069.9 to 1,602.0 acres (47 percent loss) and spawning habitat will be reduced from 1,519.8 to 729.7 acres (54 percent loss)(Table 7). The lost acreage represents 2,243 HUs. Floodplain habitat losses are substantially higher in the Floodway. Rearing habitat will be reduced from 4,230.8 to 115.8 acres (97 percent loss), and spawning habitat will be reduced from 2,179.3 to 49.3 acres (97 percent loss). The lost acreage represents 4,868 HUs. Under the Authorized Project alternative, floodplain habitat losses in the project area represent 7,111 HUs.

The A&M alternative would not significantly reduce losses of fish spawning and rearing habitat. That alternative would increase the start and stop pump elevations to 282.5 and 280.0 feet NGVD, respectively, which would only reduce the losses by 6 percent (Killgore and Hoover 1998). During the spawning period, it is expected that the gravity gates at the levee closure will remain open until the water level reaches an elevation of 282.5 feet NGVD in the New Madrid (on average of 14.3 in March and 12.9 days in April) which may allow for some fish access. It is unknown whether such actions will ensure fisheries access to the Floodway because fish movement through structures (e.g., box culverts) can be confounded by high velocities, restricted openings, and head differentials. Spawning and rearing habitat losses quantified in the HEP analysis were based on average annual acres of fisheries habitat at elevation 290' NGVD (2-year frequency flood) and below (Killgore and Hoover 1998). The acres of floodplain habitat that are inundated during larger flood events can be far higher. While such flooding occurs infrequently (> every 2 years), a substantially greater portion of floodplain habitat is available to fish during those events. For example, river stages of 295 feet NGVD were equaled or exceeded in ten of the last 35 years (i.e., 1997, 1996, 1995, 1994, 1979, 1978, 1975, 1974, 1973, 1963). Such flood events can inundate up to 47,960 acres in the New Madrid Floodway and benefit fisheries by greatly increasing available spawning and rearing habitat, as well as primary and secondary productivity associated with those areas. It should be noted that habitat losses associated with

Table 7. Direct fish spawning and rearing losses (expressed in average annual habitat units) from levee construction and pump operations. Reproductive chronology is indicated as Early (March), Mid (1 Apr-15 May), and Late (16 May-30 June).

	St. Johns Basin						New Madrid Basin					
	Spawning			Rearing			Spawning			Rearing		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Authorized Project												
Agricultural Land	35.8	626.1	140.3	1107.7	647.6	230.0	-	1191.7	315.2	3593.3	1381.5	614.6
Fallow Land	62.0	190.1	48.4	189.2	125.6	65.7	-	224.3	47.8	234.0	129.5	95.5
Bottomland Hardwoods	275.6	904.9	266.5	624.4	904.0	479.2	-	804.1	279.7	502.9	731.6	550.1
Large Permanent Waterbodies	8.8	36.1	14.6	31.1	70.2	27.3	-	187.4	79.1	195.2	439.7	158.4
Small Permanent Waterbodies	49.5	221.0	84.0	122.0	334.4	201.1	-	247.5	89.9	97.6	240.0	226.7
Total HUs Lost	431.7	1978.2	553.8	2074.4	2081.8	1003.3	-	2655.0	811.7	4623.0	2922.3	1645.3
Avoid and Minimize												
Agricultural Land	34.0	607.1	136.5	1059.6	622.1	218.2	-	1179.8	307.5	3520.5	1352.2	592.5
Fallow Land	56.8	179.8	45.4	175.7	117.1	59.6	-	212.8	43.4	221.6	122.5	87.4
Bottomland Hardwoods	243.4	827.3	241.1	555.7	813.3	419.1	-	737.8	239.2	465.4	677.1	486.8
Large Permanent Waterbodies	6.6	29.1	11.4	23.9	53.4	18.9	-	177.2	70.7	162.0	364.3	122.1
Small Permanent Waterbodies	40.3	187.6	68.4	100.5	278.4	157.5	-	221.8	72.3	82.8	202.8	178.4
Total HUs Lost	381.1	1830.9	502.8	1915.4	1884.3	873.3	-	2529.4	733.1	4452.3	2718.9	1467.2

permanent waterbodies may be overestimated under both alternatives. Although those areas will no longer be available to riverine fish, they will continue to provide habitat for resident fish. Closing the gap in the New Madrid Floodway will severe the link between the Mississippi River and its only connected tributary floodplain in Missouri. The riverine ecosystem will lose the productivity that is released by the floodplain during high water. River fishes, such as white bass, will loose most, if not all the extensive spawning, rearing, and foraging habitat provided by the Floodway. Numerous studies have examined the relationship between floodplain habitat and fisheries productivity. Lambou (1962) noted that the timing and extent of overflow on the floodplain can significantly affect the year classes of fish. Barnickol and Starrett (1951) documented a reduction in game fish in a reach of the Mississippi River with reduced backwater habitat. Levees in southeastern Missouri are associated with reduced fish diversity and abundance of characteristic floodplain species such as starhead topminnow, banded pygmy sunfish and bantam sunfish (Finger and Stewart 1978, as cited in Hoover and Killgore 1998). Where adjoining backwaters along the lower Colorado River were drained, there was a 100 percent reduction in fishery value (Beland 1953). Karr and Schlosser (1978) suggested that standing fish stocks may decline as much as 98 percent when floodplains are removed from the channel. Eliminating fish access to floodplain areas can also alter the composition of river fish communities by limiting recruitment of certain species (Turner et al. 1994). In addition, Bryan and Sabins (1979) attributed the productivity and resiliency of the populations of commercial and sport [fish] species in the Atchafalya Basin to wide variations in water levels year to year. Given the significant project-related decrease in the extent and variability of floodplain habitat available to both resident and river fishes in the study area, it is likely that both those fish stocks will decline as a result of project implementation.

The loss of fish spawning and rearing habitat in the project area could potentially affect freshwater mussel populations through alteration of the fish community. Mussels are susceptible to such changes because their life cycle includes an obligatory parasitic stage on fish. The larval stage (glochidia) of mussels must attach to the appropriate fish host to complete development (Neves 1993). The representative fish species used by Killgore and Hoover (1998) to report the losses in spawning and rearing habitat described previously include largemouth bass, white crappie, channel catfish and freshwater drum. Those fish species are important hosts for the majority of mussel species found in the project area (Table A-2). Several species, including the abundant threeridge, use sunfish (i.e., largemouth bass, bluegill and white crappie) as hosts. Catfishes serve as hosts for members of the genus *Quadrula*, and the yellow sandshell utilize gar. Several species appear to rely solely on freshwater drum. These include *Leptodea*, *Potamilus*, and *Truncilla* species. Currently, those fish species are common in the project area. Reduction or loss of those fish populations and suitable habitat, however, could potentially reduce recruitment into, or exchange among mussel populations throughout the project-area.

Killgore and Hoover (1998) quantified the reduction of instream fish spawning and rearing habitat caused by channel dredging and widening. The Authorized Project alternative will remove 60.57 acres of riverbank structure in the St. Johns basin resulting in a net loss of 145 HUs. Structure loss includes removal of logs and debris (0.8 acres), live trees (28 acres), and aquatic vegetation (32.57 acres). No other forms of riverbank structure were noted during habitat surveys. The A&M alternative would reduce the impacts to a loss of 36.17 acres or 58 HUs. Switching channel work to the opposite bank in various reaches will avoid 5.91 acres of live trees. A total of 18.83 acres of aquatic vegetation, which provides habitat for the golden topminnow (*Fundulus chrysotus*), will be avoided by designating the upper 3.7 miles of the St. James Ditch as a no work reach. Nine dikes would be constructed in lower four miles of the St. Johns Bayou which is estimated to create 3.6 HUs.

Unquantified hydrologic changes associated with the proposed channel widening may create unsuitable conditions for some aquatic life. The reduced water depths, uniform shaping and smoothing of the channel for flow conveyance, and loss of woody debris will decrease habitat diversity and food supplies for the fish community in St. Johns Bayou, and in some cases could make certain ditch reaches completely unusable by fish. Both the Authorized Project and the A&M alternatives would significantly reduce riparian forests in the St. Johns Bayou basin. Maximum water temperatures may increase substantially because of increased light absorption through removal of riparian corridor, decreased current, decreased water depths, and expanded surface water (Ebert 1993). Stern and Stern (1980) documented summer temperatures up to 12.8 degrees Celsius (° C) warmer and winter temperatures 4°C cooler in farm streams than in similar woodland streams. Similar patterns in unforested stream reaches have been noted by Hansen (1971) and Karr and Schlosser (1978). In addition, removal of the riparian corridor will reduce influxes of leaf litter to the aquatic community. Such influxes are the primary energy source for instream communities (Brinson et al. 1981). Brinson et al. (1981) note that because of shading and organic inputs, riparian vegetation plays a profound role in the structure of invertebrate communities, and indirectly in fish community structure. Because project implementation will remove (temporarily or permanently) much of the riparian forests in St. Johns Bayou basin (and to a lesser extent in the Floodway) aquatic communities are expected to be negatively affected as well.

Project-area ditches have been periodically dredged to maintain adequate drainage. Unfortunately, the timing of the faunal population recovery and species succession following dredging in those ditches is unknown. The altered environmental conditions left by dredging may benefit some species, but may threaten the existence of many others including those endemic to this region. Dredging can disrupt the entire aquatic ecosystem and cause significant losses of biodiversity. The process removes macroinvertebrate assemblages and trapped organic matter that form integral parts of the trophic web (Cummings et al. 1973, Ebert 1993). Habitat heterogeneity is reduced by the elimination of instream cover (i.e., woody debris and vegetation) which is important to the production and diversity of both invertebrates and fish (Benke et al. 1985, Marzolf 1978, Cobb and Kaufman 1993).

Other effects of dredging extend beyond the excavated area. Aquatic organisms may be adversely affected by burial, exposure to contaminants, increased turbidity, and decreased dissolved oxygen levels (Ebert 1993). Headcutting, the upstream progression of bank erosion and substrate destabilization, has occurred following dredging in low-gradient ditches similar to those found in the project area (Hartfield 1993). Headcutting has been associated with the following: extensive bank erosion; wide, degraded channels; meander cutoffs; whole trees within the channel; quicksand or otherwise loose, unstable sediments; perched tributaries at low water; and the absence of bald cypress and tupelo trees where those species are characteristic components of stable riparian ecosystems.

Dredging and widening in the St. Johns Basin will also severely impact the local mussel fauna. The most direct effect will be the physical removal and destruction of the majority of mussels in the dredge path. Potentially, some individual mussels could be missed by the dredge and survive. Barnhart (1998) found a number of mussels in Setback Levee Ditch whose ages predated the last dredging event. Those individuals were generally found along the wooded bank at sites where only one side was cleared at the time of the dredging. Since the proposed project also involves widening, the impacts to mussel are likely to be far more extensive than past dredging events.

The mussel assemblage in the project area is particularly vulnerable from the direct effects of the proposed dredging because the majority of the species have relatively small populations. Twenty of the 24 species found by Barnhart (1998) each made up less than 5 percent of the 998 individual mussels collected. The proposed dredge area contains the greatest diversity and abundance of mussels found in the project area (Barnhart 1998). A large-scale disturbance, such as dredging, has the potential to cause localized extirpation of some mussel species.

Since mussels are relatively immobile, recovery of depleted populations will depend upon recruitment of juveniles transported by fish hosts from adjacent populations unaffected by the dredging. Those "seed" populations would largely be restricted to the upper Setback Levee Ditch and the St. Johns Ditch. The mussels in those areas are relatively less abundant and species rich compared to the proposed dredged area. It is uncertain whether the Lee Rowe Ditch would serve as an adequate seed population. Although this ditch is not in the proposed dredge path, it may be severely altered. Dredging will lower the bottom of the Setback Levee Ditch and St. James Ditch. As a result, the Lee Rowe Ditch could become perched during base flows resulting in decreased water velocity. The natural succession to follow may transform this area into a more lentic environment suitable for very few mussel species (Fuller 1974, Oesch 1995).

The timing of the population recovery and species succession following dredging in lowland ditches is unknown. The degraded habitat left by the dredging is unlikely to be suitable for colonization by juvenile mussels and may require several years to recover. Since mussels are obligate parasites of fish, the recovery of specific host populations is a prerequisite to the restoration of habitat for juveniles. Considerable time may be required to restore adequate spawning habitat (i.e., snags and aquatic vegetation) for these fishes.

Endangered Species

Three federally listed species occur in the project area; the bald eagle, the pallid sturgeon, and the interior least tern. Project implementation will significantly reduce backwater flooding in the project area during spring, particularly in the New Madrid Floodway. That, in turn, will virtually eliminate seasonal use of the floodplain by Mississippi River fishes. Bald eagles have recently constructed nests in the lower Floodway in an area that will no longer be subjected to spring flooding. In addition, several least tern colonies occur adjacent to and downstream of the project area. Because of the importance of fish in the diets of both species, significant project-related impacts to fisheries production may also affect those species. The Corps has submitted a Biological Assessment to the Service and requested formal consultation on those species. The Service has concurred with the Corps that the project is not likely to adversely affect the pallid sturgeon based on insignificant effects (i.e., effects that can not be meaningfully measured or detected.). The Service prepared a June 1999 biological opinion on project effects to the bald eagle and the least tern. In that biological opinion, the Service determined that the project is likely to adversely affect the bald eagle and the interior least tern, and we developed a list of reasonable and prudent measures to minimize incidental take of those species.

Fish and Wildlife Conservation Measures

The proposed project alternatives will have significant adverse impacts on fish and wildlife resources. Although the A&M alternative will avoid important BLH tracts and maintain slightly higher water levels in both basins, that alternative would still have substantial effects on fish and wildlife. Of equal or greater concern are the indirect, project-related hydrological changes that will result in degradation and loss of fish and wildlife habitat due to the levee closure and pumping operations. Closing the gap in the New Madrid Floodway will severe the link between the Mississippi River and its only connected tributary-floodplain conplex in Missouri. The riverine ecosystem will lose the productivity that is released by the floodplain during high water. River fishes, such as white bass, will lose 100 percent of the extensive spawning, rearing, and foraging habitat provided by the Floodway. Because of the significant project-related impacts to fish and wildlife resources, the Service believes that project plans can and should be further modified to mitigate those negative impacts.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

> (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the actions; and (e) compensation for the impact by replacing or providing substitute resources or environments.

The Service's Mitigation Policy (U.S. Fish and Wildlife Service 1981) supports and adopts that definition of mitigation and considers its specific elements to represent the proper sequence of steps in the mitigation planning process. That policy identifies four resource categories to ensure that the level of mitigation recommended by Service biologists is consistent with the fish and wildlife resources affected by the project. Considering the high fish and wildlife value and relative scarcity of the forested wetlands to be impacted by the proposed project, those habitats have been designated Resource Category 2 habitats. The upper ditch reaches in the St. Johns basin contain valuable instream habitat (i.e. logs, debris, and submerged vegetation) and support diverse freshwater mussel populations which are becoming rare both regionally and nationally, and thus are also considered Resource Category 2. The mitigation goal for that resource category is no net loss of in-kind habitat value. The majority of wetlands in the project area are composed of croplands, pasture, and fallow fields. Because those wetlands provide high to medium habitat value to fish and wildlife, and are relatively abundant nationally, those habitats are considered Resource Category 3 with the mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value. What makes those areas especially important to fish and wildlife is periodic inundation during high river stages. In fact, backwater flooding is a critical factor in determining the habitat value of most of the wetlands in the project area. Such flooding provides not only habitat, but also makes floodplain productivity accessible to the riverine system. Unfortunately, such systems are also becoming increasingly scarce at both the regional and national level. Gore and Shield (1995) noted that the stability and functioning of large river ecosystems depends on maintaining watershed and floodplain integrity. Consequently, mitigation measures should ensure, to the maximum extent possible, continued connectivity between the floodplain and the river to maintain the functions of those habitats and the ecologic integrity of the floodplain-river ecosystem.

St. Johns Bayou Basin

According to the Corps, the New Madrid Floodway is hydrologically separate from the St. Johns basin. Therefore, flood control efforts in the Floodway would not address flood damage in and around East Prairie. The Service and MDC fully support measures to protect homes, businesses, and public infrastructure from flooding. However, we believe there are several alternatives to better address flooding problems in and around East Prairie that would avoid all or most of the adverse environmental impacts associated with the proposed alternatives. According to the Corps, local drainage improvements are necessary to significantly reduce municipal flooding. In combination with that work, the Corps should consider flood reduction benefits from a ring levee or similar structure (with or without pumps) to protect East Prairie from both backwater and headwater flooding. In addition, flood-proofing measures (e.g., elevate structures/roadways) should be considered to protect private property, highways, and other public infrastructure from flood damage. Such measures would avoid fish and wildlife impacts in the St. Johns Bayou basin associated with channel enlargement and lower water levels while ensuring the public safety. Moreover, those measures would also avoid adverse impacts to the New Madrid Floodway and retain the connectivity between the Floodway and the Mississippi River, as well as the habitat values and functions of the system.

If the Corps determines that more extensive work is necessary to reduce flooding in East Prairie, such work should be limited to that basin. Channel enlargement impacts to both the riparian corridor and in-stream habitat along the St. James and Setback Levee ditches, and St. Johns Bayou should be minimized to the greatest extent possible. The A&M alternative would avoid some impacts to the riparian corridor by limiting channel enlargement of the St. Johns Bayou to 120 feet, and working from only one bank, switching work in the St. James ditch to the right bank between Missouri Highways 80 and OO. The Corps has proposed to construct transverse dikes every half mile on alternating banks in the lower four miles of St. Johns Bayou to mitigate for in-stream habitat losses. Such dikes are reported to create a more natural stream morphology and provide riverbank habitat (Killgore and Hoover 1998). Before such measures can be fully evaluated, however, it should be determined whether sedimentation will occur between the rocks, which would reduce the habitat quality of those structures.

No mitigation measures have been proposed by the Corps to compensate for in-stream habitat losses in the Setback Levee or St. James ditches. While the losses under the A&M alternative are reduced, 35 acres will still be removed (Killgore and Hoover 1998). Vortex weirs, a relatively new technology to provide in-stream cover, have been proposed by MDC (Mark Boone, pers. comm.). Vortex weirs are a low-head structure consisting of series of large rocks or boulders anchored across the channel. The rocks are spaced apart to allow water to flow through. Vortex weirs have been used successfully in streams with high bedloads (similar to the project area ditches) because they allow sediment transport. In addition to providing habitat for host fishes, the weirs may also create habitat for freshwater mussels by providing substrate stability and a wide range of current velocities without creating backwater and sediment deposition which most species of unionids cannot tolerate (Fuller 1974). MDC recommends the weirs to be a minimum of 25 feet long and installed every 0.25 miles.

The A&M alternative would avoid the upper 3.7 miles of the St. James ditch to protect the aquatic vegetation that provides habitat for the golden topminnow. While this will leave the upper reach of habitat intact, additional habitat may still be affected downstream. Similar habitat occurs in the St. James ditch as far south as County Road 525. In that reach, Service and MDC biologists observed another rare species, the northern starhead topminnow, which has similar habitat requirements. Because the range of the topminnow species and its habitat in the project area have not been determined, and it is uncertain if that habitat will reestablish itself after dredging, the Corps should minimize dredging and channel modifications in the entire reach of St. James ditch that contains the topminnow's preferred habitat (i.e., quite waters with aquatic vegetation).

Several additional actions could be taken by the Corps to mitigate loss of aquatic habitat diversity, shallower water depths, higher water temperatures during the low flows, headcutting, and perching caused by channel enlargements. Transverse dikes could be constructed to offset losses from a shallower, wider channel in all work reaches. The dikes should be designed to scour a continuous, sinuous thalweg along the entire channel. The Corps has proposed such structures in the lower four miles of St. Johns Bayou (discussed previously), but as a means to create riverbank habitat. The reaches that will be affected most by reduced water depths will be the Setback Levee and St. James ditches.

Gradient control structures to prevent headcutting should be placed at the upper end of all work reaches including the St. James and Setback Levee ditches. Those structures should also be placed at the mouth of all major tributaries including the St. Johns and Lee Rowe ditches. Vortex weirs, discussed previously as a means to create in-stream fish habitat, are also designed to provide gradient control. Therefore, installing weirs may compensate for habitat losses as well as prevent headcutting. A low water weir should also be installed where the Lee Rowe ditch branches off St. James ditch to prevent perching this channel during base flows. Without these measures, aquatic habitat losses from dredging and channel widening will go unmitigated.

The dredging plan should also be modified to reduce impacts to freshwater mussels. Of the reaches surveyed in the project area, the Setback Levee ditch contained the highest mussel diversity and abundance (Barnhart 1998). Most individuals collected from that ditch were in a 6.5-foot strip along the wooded bank (right descending side). To reduce impacts to mussels, at least a 9-foot strip along the right descending side of the channel should be avoided entirely. This measure is intended to leave enough mussel breeding stock to repopulate the dredged reaches. (It should be noted that avoiding one side of the ditch would also minimize negative impacts to wildlife such as wading birds, mink, otter, and numerous reptiles and amphibians.) Because survival of mussels in that strip is uncertain, that effort should be supplemented with mussel relocation from sites within the dredge path to other areas in the project area. In addition, a monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of mussel mitigation measures. Although the dikes, weirs, and gradient control structures all have potential to provide suitable mussel habitat, mussel use of those structures has not been evaluated. Therefore, the mussel monitoring plan should also include long-term monitoring to determine the value of those structures as mussel habitat. The monitoring program should quantify changes in population densities and habitat conditions over time and determine the timing of population recovery in dredged reaches. Given the longevity of unionids, populations should be monitored prior to project construction and for at least 10 years post project. The information gained from that study could be used to better evaluate and manage impacts to mussels in future projects.

New Madrid Floodway

The proposed work in the New Madrid Floodway will have significant negative effects on fish and wildlife resources. Therefore, if the Corps determines that flood control measures are required in the Floodway, we strongly encourage them to consider other alternatives that would avoid most of the adverse environmental impacts associated with either of the proposed alternatives. For example, a non-structural alternative such as the use of flood easements in the lower portion of the Floodway could reduce flood-related agricultural damages while ensuring that area will continue to provide habitat to nationally significant fish and wildlife resources. (That measure could also be considered for the St. Johns basin.) The Service has recently learned of efforts coordinated by the Business Council for Sustainable Development, Gulf of Mexico, to reforest up to 1 million acres of marginal farmlands in the lower Mississippi River Valley. The goals of the program are to improve water quality, recreation, and fish and wildlife habitat; provide an economically viable alternative to farming flood-prone lands; ensure adequate future supplies of forestry products, and provide communities with a sustainable way to diversify their economic base. The Service strongly supports such efforts and believes the Corps should further consider this and similar efforts as a way to reduce flood damages in the project area while enhancing fish and wildlife resources, and providing diverse, sustainable benefits to the local and regional economies.

Another option to avoid impacts to fish and wildlife is an alternative levee alignment further north in the Floodway. MDC has recently proposed an alternative levee alignment that would extend north from the mainline levee east of Big Oak Tree State Park to Barkers Ridge (a natural watershed divide) and follow that ridge to the Setback Levee. The Floodway north of the levee would drain through a structure where St. James Bayou intersects the Mississippi River mainline levee. This would preserve thousands of acres of floodplain as habitat for numerous fish and wildlife, but would also maintain the ecologic functions (e.g., primary and secondary productivity export to the river, flood water storage, etc.) of floodplain wetlands by ensuring hydrologic connectivity between the floodplain and the river.

Of the two proposed alternatives, the A&M alternative would have fewer negative impacts to fish and wildlife in the Floodway. The Service and MDC, however, believe there are additional measures that would further reduce fish and wildlife impacts. In the A&M alternative, the drainage structures will remain open in the St. Johns basin and New Madrid Floodway an average of 14.4 and 12.9 days (i.e., the average number of days interior water levels are expected to be higher than river stages, and thus allow drainage to the river) in March and April respectively. Although that operation plan potentially provides Mississippi River fish limited access to floodplain habitats during part of the spawning season, the extent of fish movement through the box culverts is unknown (Killgore and Hoover 1998). Furthermore, that alternative would still cause significant losses of floodplain spawning and rearing habitat. If river fish were able to access those basins, little if any of the existing floodplain would be inundated at that time under either proposed project alternative.

St. Johns Bayou Basin and New Madrid Floodway

The most effective measures to mitigate project impacts would maintain the natural connectivity and water level variability of the floodplain which, in turn, would protect the ecologic functions of project-area wetlands. The Service has suggested to the Corps that the pumps be operated according to a "Rule Curve" that would ensure the greatest interchange possible between the Floodway and the river. Such a plan would have both outlet structures open to allow flooding up to the elevation that avoids inundation of important public infrastructure. Pump operations could be determined by a that would have specified target elevations during the spring fish spawning season. The purpose of a "Rule Curve" is to use a combination of gate openings, target elevations, and pumping to prevent damaging water levels, while allow some interchange between the river and the Floodway. For example, if river stages exceeded the trigger elevation, the gates could be closed and water levels reduced (via pumping) to (or slightly below) the trigger elevation, so that the gates could be reopened. Such measures would allow for more floodplain-river interchange (and fish and wildlife habitat) in the St. Johns Bayou basin while reducing some of the negative project impacts to the New Madrid Floodway by increasing the time the drainage structures would remain open.

An operational rule curve would also promote the long-term variability in water depths important to wetland invertebrate production, wetland plant response during the growing season, and overall wetland health. In addition, such operations would allow much of the lower basins to flood naturally during wet years when they would have the greatest waterfowl use. In addition to the fish and wildlife benefits, we believe that such a plan has the potential to lower long-term pumping costs in comparison to the proposed plans. According to Corps' analyses, however, sump elevations could be raised only approximately 6 inches without affecting the economic benefits of the project. Unfortunately, such operations would produce minimal habitat benefits, and increase fisheries access less than a day.

The following sections address quantitative mitigation requirements to compensate for project-related losses to fish and wildlife habitat value. Ideally, those measures would be conducted within the affected basin to ensure that wetland and floodplain ecologic functions were conserved in the project area. In this case, however, it will be impossible to compensate habitat losses within the project area. Even with the proposed A&M alternative, fisheries access through the drainage structure to the floodplain will be drastically reduced in the Floodway. The 1,500-foot gap in the levee that currently provides river fish access to floodplain habitats throughout the spring spawning season (i.e., March - June) will be restricted to a single 10-foot by 10-foot box culvert that would be open only periodically during part of the spawning season (i.e., an average of 14.3 and 12.9 days in March and April respectively), generally during lower river stages. There no measures within the project area to fully mitigate the loss of the natural connectivity between the Mississippi River and the New Madrid Floodway as a result of either proposed alternative. In addition, after project implementation, not only would fisheries access into the basins be reduced, but suitable habitat would be almost eliminated. In March, during the spring spawning season and waterfowl and shorebird migration, median monthly water levels in the project area would flood only 154 acres of farmed wetlands in the St. Johns Bayou basin, and 56 acres in the Floodway.

Floodplain habitats that will be substantially reduced by the project include cropped agricultural land (CAG) (including farmed wetlands), fallow land, BLH forests, and seasonally connected large and small permanent water bodies. The Corps has proposed to convert flooded agricultural land to BLH forest to compensate fisheries habitat losses of seasonally inundated CAG, fallow land, and forested wetlands. Since forested wetlands generally have higher fisheries habitat value than seasonally inundated CAG or fallow land, well as wildlife, we believe that re-establishing forested wetlands can be an effective measure to compensate losses of floodplain fisheries habitat losses, provided the site has significant access for riverine fish from March through June (See details on reforestation below). The compensation acreage in Table 8 is designed to mitigate losses of rearing habitat during April and May (mid-season). Although the fisheries HEP model shows substantial early-season rearing losses in both basins, much of those losses are attributable to changes in white bass habitat. Sheehan (1998), however, did not record white bass in spring sampling in the St. Johns Bayou basin. In addition, according to the HEP model, agricultural fields, rather than forested wetlands, appear to have a higher suitability index for larval white bass, which would derive minimal benefit from reforestation as a compensation measure. Therefore, we believe mid-season habitat losses better reflect habitat changes to a larger number of both floodplain and riverine species, and compensation based on those losses would benefit the majority of the fish fauna.

Table 8. Comparison of acres needed for reforestation to compensate for spawning and rearing floodplain habitat losses (excluding permanent waterbodies) in the St. Johns Basin and New Madrid Floodway. (average annual acres)

St. Johns Bayou Basin	**Authorized**	**A&M**
CAG	1,173	1,086
Fallow	1,597	1,479
New Madrid Floodway	**Authorized**	**A&M**
CAG	6,796	6,520
Fallow	7,475	7,173

CAG = seasonally inundated agricultural land
Fallow = seasonally inundated unplanted land

The Service recommends that rearing acres be mitigated because of their importance to fisheries and their ecological functions. Since little is known of the distribution of larval fishes in floodplain habitats, there has been some debate on the need to mitigate rearing habitat losses of areas less than 1 foot deep and flooded agriculture fields (inlcuding farmed wetlands). Available data on fish use of flooded agricultural fields is varied. Hoover and Killgore (1996) collected larval fish from various floodplain habitats in the Big Sunflower River system in Mississippi. Invasive and ubiquitous species such as carp and shad were most often found on flooded agricultural and fallow land. Other species were concentrated around bottomland hardwoods. In contrast, data from extensive fish sampling of floodplain habitats near Cape Girardeau, Missouri show other fish species use agricultural fields as rearing habitat. In 1993, large numbers of larval fish were collected by trawl from agricultural fields up to 3/4 of a mile away from permanent waterbodies. The most abundant larval fishes were drum, silversides, various species of minnows, and several species of darters (Bob Hrabik, Cape Girardeau Long-term Resource Monitoring Station, pers. comm., 1998).

We know of only one study that quantified the relationship between water depth and larval fishes (Killgore and Hoover 1996). In that study, fishes were sampled from the Yazoo River system in Mississippi. From these collections, Killgore and Hoover concluded that water less than one foot is not extensively used by larval fishes. Bob Hrabik (pers. comm.), however, collected various species of minnows from flooded agricultural fields in water less than one foot. He believed that larval fish were most likely present in those areas but are not often sampled with electroshocking. While larval fishes may prefer slightly deeper water, those shallow waters do provide habitat and significant floodplain functions (detrital input, nutrient cycling, floodwater storage, etc.). The wide-spread, shallow flooding in the project area provides a large surface area for planktonic production driven by sunlight and warm temperatures. It is generally accepted that floodplain waters (including shallow waters) are important for the production of phytoplankton and zooplankton (Robert Sheehan, pers. comm.), which are the principle food source for larval fish (Pflieger 1997). In addition, a major factor involved in the transition of larval fish from endogenous (yolk sac) to exogenous nutrition is the density of food organisms (Hall and Lambou 1990). As previously mentioned, Hrabik (1994) noted the extremely high zooplankton productivity on a wide floodplain near Cape Girardeau. Because larval fish use shallow-water habitat and because of the contribution of that habitat to the primary and secondary productivity of the floodplain, the Service recommends that all fish rearing habitat losses be fully compensated. From a practical standpoint, it would be very difficult to ensure that all compensation acres meet the spawning criteria (i.e., flooding > 1 foot for 8 days or more) to replace spawning habitat losses over an area of such small topographic relief. Although water depth and duration depend on the characteristics of a particular site, Corps hydrologic modeling shows that spawning acres account for only a portion of the area inundated under natural flooding patterns. Therefore, achieving the necessary compensation acres to meet the spawning criteria may involve inundating considerably more acreage.

Ideally, mitigation lands should be located in an area currently not subject to flooding, but with potential to restore the hydrology to a functioning forested wetland. The greatest habitat gains would result from reforesting an area that does not flood (hence no existing fisheries value), but has the potential for restored wetland hydrology. Such a site, however, would most likely involve significant water management and fisheries access issues. Locating compensation area(s) on farmed wetlands would address the hydrology, but result in a net loss of wetland acreage due to the project. In addition, the value of restoration lands designed to compensate lost fisheries habitat differs greatly with location and flooding regime. The estimated acreage is an annual average over the life of the project (consistent with the methods used to assess existing habitat value). That means over the next 50 years, the mitigation tract(s) must provide functions equivalent to those acres, taking into account effects of variable river flooding. For example, a selected track is inundated only 60 percent of the years, then additional acres may be required to provide the remaining 40 percent of the mitigation value necessary to compensate for those habitat losses.

Another confounding factor is flooding duration. If the mitigation tracts are inundated March through June, they could potentially compensate for the early, mid, and late spawning and nursery needs. Unfortunately, such an extended flooding period is not compatible with reforestation of bottomland hardwood tree species. Many previous reforestation projects in the lower Mississippi River Valley have met with poor success because of problems with modified flooding regimes that can drown seedlings and/or acorns. Although reforestation benefits many fish species, the proposed compensation acreage will not meet the substantial spawning and rearing needs of the white bass. Flooded cropland and fallow fields provide greater habitat value for that species. Therefore, we recommend that the Corps consider measures to seasonally inundate cropland during the month of March to meet the habitat needs of white bass. Possibly such flooding could also be used to compensate for spring shorebird habitat losses (see below).

The Corps had previously suggested creating borrow pits to partially mitigate for habitat losses of seasonally connected large and small permanent water bodies on the floodplain, including natural oxbow lakes. Although the functional similarity of borrow pits and oxbow lakes is unknown, borrow pits have been shown to function as effective fish nurseries if they are properly constructed (Sabo and Kelso 1991). The Corps recently adopted guidelines for borrow pit construction along the lower Mississippi River (Aggus and Ploskey 1986). Several features important to fisheries are high shoreline to surface-area ratio; various depths, both shallow and deep (as refuge); various substrate materials; and riparian vegetation. Those guidelines stressed the importance of maintaining connections to the Mississippi River so that spawning adults can access the ponds and young-of-the-year fish can escape when conditions in the ponds become stressful. Permanent waterbodies appear to be particularly important as nursery habitat for larval fish (J. Killgore, pers. comm.). Killgore and Hoover (1996) noted that larval fish were found most often in waters greater than 1 foot deep. To provide in-kind mitigation for project-related habitat losses, it would be necessary to construct approximately 321 acres of borrow pits under the Authorized Project alternative and 261 acres under the A&M alternative. Because of the expense of borrow pit construction, the Corps' original proposal would result in only a small portion of permanent waterbody habitat losses mitigated in-kind. More recently, the Corps is recommending reforesting flooded croplands to compensate for permanent waterbody habitat losses. In light of the cost constraints and minimal habitat gains from the proposed borrow pit construction, the Service has agreed to reforestation as an appropriate mitigation measure. Table 9 details the reforestation acres needed to compensate (albeit out-of-kind) for fisheries habitat

Table 9. Reforestation acres needed to compensate for permanent floodplain waterbody habitat losses in the St. Johns Basin and New Madrid Floodway. (average annual acres)

	Authorized Project	A&M
St. Johns Bayou Basin		
CAG	283	232
Fallow	385	316
New Madrid Floodway		
CAG	2,060	1,718
Fallow	2,266	1,890

CAG - seasonally inundated agricultural land
Fallow - seasonally inundated unplanted land

losses associated with permanent waterbodies. The estimates were based on habitat value necessary to mitigate mid-season rearing habitat, which would also compensate for spawning habitat losses as well. Given the importance of permanent waterbody habitat to larval fish, however, we recommend that the Corps provide in-kind habitat compensation for those losses to the maximum extent possible. This could be done by purchasing mitigation lands that include permanent waterbodies that could be improved (i.e., reforest or regrade old borrow pits) or reconnected to the Mississippi River (i.e., old chutes, sloughs, or oxbows). Such areas should allow *significant* fisheries access to riverine species from March through June to realize the estimated habitat benefits. In addition, to compensate for losses to recreational fishing we recommend that the Corps ensure public access to those waterbodies through fee-title purchase or easements.

Habitat value of forested wetlands in the project area will decline significantly because of channel enlargement, levee closure, and pumping operations. To compensate for that habitat loss, we recommend that the Corps purchase croplands in fee-title to be reforested. Reforestation can be a very effective and efficient compensation measure. Depending on the location and flooding regime, restoration of forested wetlands could meet the needs of forest wildlife, waterfowl, and fisheries. Ideally, those lands should be located in an area currently not subject to flooding, but with potential to restore the hydrology to a functioning forested wetland. As previously mentioned, locating compensation area(s) on farmed wetlands would result in a net loss of wetland acreage due to the project. In addition, as shown in the fisheries analyses, farmed wetlands have important habitat value and their use would further increase the acreage required to compensate habitat losses. Specific details on species mix and reforestation methods will depend on the location of the compensation site(s) (e.g., soil, flooding regime, size, etc.) and will be developed by the Service and MDC. In general, however, compensation acres should be directly seeded, weeds controlled for a minimum of five years, and 70 percent tree survival attained at the end of five years. If necessary, at the end of five years, the area should be replanted and weed control implemented until the 70 percent survival threshold is met.

The project will directly decrease forested wetland habitat value in the project area by 2,820 and 2,058 AAHUs under the Authorized Project and A&M alternatives, respectively. To compensate that habitat loss, approximately 2,118 acres (Authorized Project alternative) or 1,546 acres (A&M alternative) of croplands should be reforested as described above. It should be noted that full replacement of forested wetland functions will not occur for many years given the time needed to grow large, mature trees. We estimate that it will take at least 50 years for a mitigation site to approach the habitat quality that currently exists in the project area. In addition, using the direct seeding method, the mitigation site will not compensate for lost habitat value for such species as the pileated woodpecker (an evaluation species) which require the large trees and structural complexity found only in mature forested wetlands. There is an experimental method, however, that may provide some of that habitat value within the project life. The root production method (RPM) has been shown to give young trees a several years "head start" (i.e., mast production within 7-10 years)(B. Allen and D. Wissehr, MDC, pers. comm.). Because of this potential and its experimental nature, we recommend that the Corps plant a portion (≤ 15 percent) of the compensation area with trees subject to RPM to possibly compensate for mature BLH habitat losses. In rare instances, preservation of an existing high quality tract of forested wetlands, may be an acceptable compensation measure. Such cases, however, occur when there is no suitable acreage to reforest. Preservation is another instance where compensating wetland habitat losses with existing wetlands results in a net loss of wetlands in a project area.

We believe there will be significant indirect, project-related effects to forested wetlands because of hydrologic changes (i.e., eliminating seasonal inundation). As previously mentioned, conversion of forested wetlands to other land uses (primarily agriculture) would result in a loss of approximately 2,823 AAHUs in the St. Johns basin, and 6,496 AAHUs for the Authorized Project or 6,217 AAHUs for the A&M alternatives in the New Madrid Floodway. The Phase I General Design Memorandum for the St. Johns and New Madrid Floodway project recognized the value and vulnerability of remaining forested wetland in the project area (U.S. Army Corps of Engineers 1980). We believe that it is still appropriate to protect important bottomland hardwood wetland habitats in the project area from future conversion. Under either project alternative, the most effective means to avoid the complete loss of forested wetland function within the project area is to prevent the conversion of those remaining forested wetlands through protective covenants. A restrictive covenant or some other appropriate protective measure should be used to prevent the clearing of all existing unprotected forested wetlands that will no longer be seasonally inundated. Those include privately owned tracts that are not being managed for timber or enrolled in wetlands restoration programs (i.e., WRP). Based on the Corps hydrologic analyses, such measures should cover forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns Bayou basin, and 290 and 277 feet (Authorized Project) or 281 feet (A&M) NGVD in the New Madrid Floodway. Those measures would also preserve the habitat value of mature BLH forests, which is unlikely to develop on reforested compensation areas over the project life.

If the protective measures for forested wetlands mentioned above are not implemented, we recommend that the Corps purchase in fee-title, sufficient croplands to fully compensate habitat losses from induced development of those wetlands. Using the same reforestation methods described above, approximately 2,120 acres would be necessary to compensate for project-related habitat losses in the St. Johns Bayou basin. In the New Madrid Floodway, 4,878 or 4,669 acres would be required to compensate for forested wetland habitat losses from the levee closure and pump operations under the Authorized Project and A&M alternatives, respectively.

Implementation of either project alternative will greatly reduce waterfowl habitat values during spring migration. Using the WAM to estimate spring waterfowl carrying capacity in the project area, the Authorized Project alternative will reduce waterfowl habitat value by 71,527 DUDs in the St. Johns basin, while both alternatives would lead to habitat losses in the New Madrid Floodway: 215,373 DUDs under the Authorized Project or 215,645 DUDs under the A&M alternative. Therefore, we recommend that the Corps re-establish forested wetlands, as previously described, to compensate for those habitat losses. Not only will reforestation meet the food requirement of migrating waterfowl, but forested wetlands will also provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Assuming that the compensation sites are reforested with a mix of 70 percent red oak species, approximately 1,221 acres would be necessary to compensate for habitat losses in both basins under the Authorized Project alternative. Under the A&M alternative, 891 reforested acres would be necessary to compensate for project-related habitat losses which would be limited to the Floodway. Acres reforested to compensate for BLH wetland losses and fisheries habitat losses could also compensate waterfowl habitat losses, provided the flooding regime was appropriate. Acreage to compensate for spring waterfowl habitat losses should be flooded only to a depth of 18 to 24 inches to be accessible to most dabbling and diving ducks in the project area.

Spring shorebird migration habitat will also be significantly reduced under either of the proposed project alternatives. In the St. Johns basin, habitat value would decrease approximately 30 percent, while in the Floodway either project alternative would cause a 70 percent decrease in spring shorebird habitat value. To compensate for those habitat losses, we recommend the Corps secure, either through fee-title or easements, appropriate acreage (that would not be flooded under future project conditions) to be managed for shorebirds during April and May. As shown in Table 10, moist soil areas provide more habitat value per acre than flooded cropland, so fewer compensation acres of that habitat type would be needed. In addition, depending on the depths

Table 10. Acres needed to compensate spring (April and May) shorebird habitat losses. (average annual acres)

	Authorized Project	A&M
St. Johns Bayou basin		
flooded cropland	238	209
moist soil areas	120	105
New Madrid Floodway		
flooded cropland	1345	1314
moist soil areas	676	660

of and access to an area, shallow flooded croplands or moist soil acreage could be used to offset a small portion of the habitat losses to fisheries and waterfowl. Structures within the existing drainage network in the project area could possibly be used to seasonally trap rainwater on agricultural lands to provide spring shorebird habitat. Alternatively, areas could be engineered, by installing small dikes and pumping systems, to control water levels regardless of precipitation or backwater flooding (i.e., moist soil units). Both those measures, however, would largely reduce or eliminate fisheries access at that site. Furthermore, although shallow water along the edges of borrow ditches may be suitable for shorebirds, existing borrow pits in the project area do not receive much shorebird use (B. Allen and D. Wissehr, MDC, pers. comm.). That may be related to the size of the borrow pits, or the presence of tall riparian vegetation and proximity to the Setback Levee both of which could obstruct the birds long-range vision.

Table 11 summarizes the reforestation needs for various fish and wildlife by basin. Although project impacts in the Floodway were not further broken down by project feature (i.e., levee closure and pump operations), most of the indirect wetland impacts in the Floodway (and all the indirect wetland impacts in the St. Johns basin) result from the proposed pumping operations. The Corps has proposed reforesting 9,560 acres of frequently flooded agricultural fields near the project area to compensate for habitat losses to fisheries habitat. As Table 10 shows, that acreage could also offset project-related impacts to forested wetlands and waterfowl in both basins. Although the Corps recognizes the importance of mitigation in the area of project impacts, we have noted previously that there will not be suitable habitat under post-project conditions to reestablish forested wetlands within the basins. In addition, the Corps has noted to the Service that restoration of significant acreage of lands within the project-area could greatly reduce the economic benefits of the project.

Table 11. Summary of reforestation acreage to compensate fish and wildlife habitat losses by basin for each alternative. (average annual acres)

	St. Johns		**New Madrid**	
Forested wetlands	Author. Proj.	A&M	Author. Proj.	A&M
direct	2,068	1,496	50	50
indirect	2,120	2,120	4,878	4,669
Fisheries				
floodplain	1,173	1,086	6,795	6,521
perm. waterbody*	283	232	2,060	1,718
Waterfowl	305	0	916	891

* reforestation acres

Another important factor in the feasibility of implementing the recommended mitigation measure is the Corps' policy that relies on purchasing mitigation lands from willing sellers. Considering the strong local support for the project, finding enough interested willing sellers is extremely unlikely. Furthermore, while it is also Corps policy to compensate project impacts concurrently with project construction, reliance on willing sellers places significant constraints on both the timing of land acquisition as well as the location of those acquired lands. The mitigation acreage necessary for each species group is based on those acres *in place and functioning* when project construction is complete. In addition, for lands to offset both wetland and fisheries impacts, they must have significant inundation and fisheries acres in the spring while also able to support viable bottomland hardwood forest species. Acres that mitigate waterfowl impacts must be flooded no more than 24 inches to be accessible to most dabbling and diving ducks in the project area. Given the hydrology and large acreage necessary to compensate project impacts, acquiring suitable land from willing sellers in a timely manner would seem to present a great challenge to the Corps and the local sponsors.

The Service supports the Corps' policy of mitigation acquisition during project construction because it is critical to adequately compensate project-related impacts to fish and wildlife. However, we also recognize that circumstances beyond the Corps' control may significantly delay or otherwise impede timely implementation of the mitigation plan. That could result in significant unmitigated adverse impacts to fish and wildlife resources. Therefore, to ensure that fish and wildlife resources are conserved, we recommend that the Corps not operate either of the pump stations until mitigation for that project feature is in place. The Corps should include that condition as part of the operation plans for both pumping stations. To provide some flexibility, if a significant portion of the mitigation for the pump stations is in place by the time project construction is complete, the Service offers to work with the Corps to develop an alternative pump operation plan that would ensure those operations result in impacts no greater than what has been mitigated for at that time. The Service recommends that such operation guidelines become an integral part of the either alternative. We believe adherence to those guidelines is the only way to ensure that fish and wildlife resources receive equal consideration with other project purposes.

Summary and Recommendations

Both proposed project alternatives will eliminate spring overbank flooding that currently may cover ten of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by either project alternative. Seasonal backwater flooding in the New Madrid Floodway provides important floodplain habitat that supports an extremely abundant and diverse fish fauna (both floodplain and riverine), some of which are becoming regionally scarce. The interchange between the Floodway and the river supports a sustainable ecosystem not found elsewhere along the Mississippi River in Missouri. Alterations in the extent and timing of seasonal flooding in the project area greatly concern the Service not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

The Corps has proposed reforesting 9,560 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate losses of wetland habitat value, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, water quality changes, etc.. Fish and wildlife species with limited mobility (i.e., reptiles and amphibians) will experience a net loss of habitat within the project area that may not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Because the project will negatively affect nationally significant fish and wildlife resources in the project area, the Service recommends that the Corps implement the following measures to ensure that fish and wildlife receive equal consideration with other project purposes:

1.) Consider alternatives that specifically address East Prairie flooding problems, including ring levees, flood-proofing, and local drainage improvements. If additional flood control work is necessary, limit that work to the St. Johns Bayou basin. Work in the New Madrid Floodway will not provide flood relief to areas in and around East Prairie.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures.

a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. They may also function as grade control structures.

e.) Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

f.) Avoiding dredging in an 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements, etc.) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the proposed alternatives, they should incorporate the following measures as integral features of the selected plan.

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns basin, and between 290 and 277 (Authorized Project) or 281 feet (A&M) NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures. (average annual acres)

1.) Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). Approximately 2,118 acres (Authorized Project) or 1,546 acres (A&M) would be needed to mitigate direct project impacts. If protective covenants have not been placed on BLH forest as described in 4(b), the Corps should reforest an additional 6,998 acres (Authorized Project) or 6,788 acres (A&M) to compensate for induced forested wetland losses because project-related reductions in flooding.

2.) Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

3.) Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below). Approximately 7,968 acres (Authorized Project) or 7,607 acres (A&M) of flooded agricultural lands would be necessary to mitigate those habitat losses.

4.) To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest an additional 2,343 acre (Authorized Project) or 1,950 acres (A&M) of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

5.) Provide shallow flooded (i.e., ≤ 18 inches) land in April and May to compensate for project-related losses in shorebird migration habitat. (Such areas could also partially compensate for losses to fisheries and waterfowl habitat.) Approximately 1,583 acres (Authorized Project) or 1,523 acres (A&M) of flooded cropland would be necessary to compensate shorebird habitat losses. Constructing moist soil areas to mitigate those losses would roughly halve the necessary acreage.

6.) Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with project construction and should be in place prior to project operation.

Service Position

The Service and the Corps have strived to develop measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate cover types (i.e., BLH, moist soil, borrow pits), only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, habitat functions must also be maintained. While the proposed mitigation plan would potentially compensate fish and wildlife habitat losses that can be quantified with current models for estimating wildlife effects of water development projects, it would not sustain all the important ecologic functions of the floodplain-river ecosystem in the project area.

The Service opposes the St. Johns Bayou and New Madrid Floodway preferred alternative because:

1.) As proposed, the preferred alternative would cause substantial, irretrievable losses of nationally significant fish and wildlife resources, and greatly diminish rare and unique habitats found in southeast Missouri.

2.) We believe project-related wetlands losses are at odds with the Administration's conservation policy goals and those of the Clean Water Action Plan.

If the Corps proceeds with project construction, at a minimum, they should include the Service's above-mentioned recommendations as integral components of the project.

LITERATURE CITED

Aggus, L.R. and G.R. Ploskey. 1986. Environmental design considerations for main stem borrow areas along the lower Mississippi River. U.S. Army Corps of Engineers, Lower Mississippi River Environmental Program, Report 4, Vicksburg, Mississippi.

Ahlstedt, S.A. and J.J. Jenkinson. 1993-1994. A search for additional populations of *Potamilus capax* in the St. Francis and Cache River Watersheds, Arkansas and Missouri, U.S.A. *Walkerana* 7(17/18): 71-157.

Ahlstedt, S.A. and J.J. Jenkinson. 1991. Distribution and abundance of *Potamilus capax* and other freshwater mussels in the St. Francis River System, Arkansas and Missouri, U.S.A. *Walkerana*, 5(14):225-261.

Ahlstedt, S.A. and J.J. Jenkinson. 1987. Distribution and abundance of *Potamilus capax* and other freshwater mussels in the St. Francis River system, Arkansas and Missouri. Tennessee Valley Authority. Knoxville, Tennessee. 43 pp. + Appendices.

Amoros, C. 1991. Changes in side-arm connectivity and implications for river system management. *Rivers* 2(2):105-112.

Askins, R.A., J.F. Lynch and R. Greenberg. 1990. Population declines in migratory birds in eastern North America. *Current Ornithology* 7:1-57.

Baker, J.A., K.J. Killgore, and R.L Kasul. 1991. Aquatic habitats and fish Communities in the Lower Mississippi River. *Aquatic Sciences* 3(4):313-356.

Barnhart, M.C., A.D. Roberts, and F. Riusech. 1996. Reproductive biology and ecology of the flat floater mussel, *Anodonta suborbiculata*, Say in Kansas. Project report, Kansas Department of Wildlife and Parks. 52 pp.

Barnhart, M.C. 1998. A survey of unionid mussels in the St. John's Basin and the New Madrid Floodway. A report submitted to the Memphis Corps of Engineers.

Barnickol, P. and W. Starrett. 1951. Commercial and sport fishes of the Mississippi River between Caruthersville, Missouri and Dubuque, Iowa. *Bulletin of the Illinois Natural History Survey* 25:267-350.

Beland, R. 1953. The effect of channelization on the fishery of the lower Colorado River. *California Fish and Game.* 39:137-139.

Bellrose, F.C. and R.D. Crompton. 1970. Migrational behavior of mallards and black ducks as determined from banding. *Illinois Natural History Survey Bulletin* 30:167-234.

Benke, A.C., R.L. Henry, III, D.M. Gillespie, and R.J. Hunter. 1985. Importance of snag habitat for animal production in southeastern streams. Fisheries Vol. 10, No. 5.

Brinson, M.M., B.L. Swift, R.C. Plantico and J.S. Barclay. 1981. Riparian Ecosystems: their ecology and status. Fish and Wildlife Ecological Service Biological Report FWS/OBS-81/71. 154 pp.

Bryan, C.F. and D.S. Sabins. 1979. Management implications in water quality and fish standing stock information in the Atchafalaya Basin, Louisiana. Pages 293-316. *In*, J.W. Day, Jr. and R.H. Chabreck (eds.), Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University, Department of Continuing Education, Baton Rouge.

Carter, R. And C.T. Bryson. 1991. A report of *Cyperus grayoides* and *C. retroflexus* (CYPERACEAE) new to Missouri, and notes on other selected Missouri *Cyperus*. *Sida* 14(3):475-481.

Cobb, S.P. and J. Kaufman. 1993. Clearing and snagging. Pages 169-180. *In* C.F. Bryan and D.A. Rutherford (eds). Impacts on warmwater streams: guidelines for evaluation. Southern Division, American Fisheries Society, Little Rock, AR.

Constants, G.C., W.W. Kelso, D.A. Rutherford, and C.F Bryan. 1997. Habitat, Movement and Reproductive Status of Pallid Sturgeon *(Scaphirhynchus albus)* in the Mississippi and Atchafalaya rivers. US Army Corps of Engineers, New Orleans District. 64 pp.+ appendices.

Cummings, K.S., M.E. Retzer, C.A. Mayer and L.M. Page. 1990. Life history aspects and status of the Federally endangered fat pocketbook, *Potamilus capax* (Green 1832) (Mollusca:Unionidae), in the Lower Wabash River, Illinois and Indiana. Technical Report 1990 (1). Illinois Natural History Survey. Champaign, Illinois. 37 pp.

Cummings, K.W., R.C. Peterson, F.O. Howard, J.C. Wycheck and V.I. Holt. 1973 The utilization of leaf litter by stream detritivores. *Ecology* 54:336-345.

Ebert, D.J. 1993. Dredging. 157-167 pp. *In* C.F. Bryan and D.A. Rutherford (eds), Impacts on warmwater streams: guidelines for evaluation. Southern Division, American Fisheries Society, Little Rock, AR.

Eckblad, J.W., C.S. Volden and L.S. Weilgart. 1984. Allochthonous drift from backwaters to the main channel for the Mississippi River. *Canadian Journal of Zoology* 66:352-363.

Environmental Science and Engineering, Inc. 1978. Inventory of water quality and aquatic biology, Mississippi County Spillway Watershed and Peafield drainage. Final Report, Contract No. AG29SCS-00638. 179 pp.

Fredrickson, L.H. and D.L. Batema. 1992. Greentree Reservoir Management Handbook. Gaylord Memorial Laboratory, Wetlands Management Series, Number 1. 79 pp.

Fredrickson and Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323. *In*, M.W. Weller (ed.), Waterfowl in Winter - a symposium. Univ. Minnesota Press, Minneapolis, MN.

Fremling, C.R., J.L. Rasmussen, R.E. Sparks, S.P. Cobb, C.F. Bryan and T.C. Claflin. 1989. Mississippi River fisheries: a case history. Pages 309-351. *In*, D.P. Dodge (ed.), Proceedings of the International Large River Symposium. Can. Spec. Publi. Fish. Aquat. Sci. 106.

Fuller, S.L.H. 1974. Clams and mussels (Mollusca: Bivalvia). Pages 215-273. *In*, C.W. Hart, Jr. and S.L.H. Fuller (eds.), Pollution ecology of freshwater invertebrates. Academic Press, New York.

Galat, D.L., L.H. Fredrickson, D.D. Humburg, K.J. Bataille, J.R. Bodie, J.D. Dohrenwend, G.T. Gelwicks, J.E. Havel, D.L. Helmers, J.B. Hooker, J.R. Jones, M.F. Knowlton, J. Kubisiak, J. Mazourek, A.C. McColpin, R.B. Renken and R.D. Semlitch. 1998. Flooding to restore connectivity of regulated, large-river wetlands. *BioScience Vol. 48 No. 9: 721-733.*

Gallagher, R.P. 1979. Local distribution of icthyoplankton in the lower Mississippi River, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 52 pp.

Gore, J.A. and F.D. Shields, Jr. 1995. Can large rivers be restored? *BioScience* (45)3:142-152.

Guillory, V. 1979. Utilization of an inundated floodplain by Mississippi River fishes. *Florida Scientist*, 42(4):222-228.

Hall, H.D. and V.W. Lambou. 1990. The ecological significance to fisheries of bottomland hardwood systems: values, detrimental impacts, and assessment: the report of the fisheries workgroup. *In* J.G. Gosselink, L.C. Lee, and T.A. Muir (eds.), Ecological processes and cumulative impacts. pp. 481-531. Lewis Publishers Inc.

Hansen, D.R. 1971. Stream channelization effects on fishes and bottom fauna in the Little Sioux River, Iowa, 29-15 pp. *In* E.Schenberger and J.L. Funk (eds.), Stream channelization: a symposium. Special Publication No. 2, North Central Division, American Fisheries, Society, Omaha, Nebraska.

Hartfield, P. 1993. Headcuts and their effect on freshwater mussels. Pages 131-141. *In* K.S. Cummings, A.C. Buchanan, and L.M. Koch, (eds.), Conservation and management of freshwater mussels. Proceedings of a UMRCC symposium, 12-14 October 1992, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Heimlich, R.E., K.D. Wiebe, R. Claassen, D. Gadsby and R.M. House. 1998. Wetlands and Agriculture: Private Interests and Public Benefits. U.S. Department of Agriculture, Agricultural Economic Report No. 765. Resource Economics Division, Economic Research Service, Washington, D.C. 94 pp.

Heitmeyer, M.E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the upper Mississippi Delta. Ph.D. Thesis, Univ. Missouri, Columbia. 376 pp.

Helmers, D.L. 1992. Shorebird management manual. Western Hemisphere Shorebird Reserve Network, Manomet, MA. 58 pp.

Hoggarth, Michael A. 1992. An examination of the glochidia-host relationships reported in the literature for North American Species of Unionacea (Mollusca:Bivalvia). Malacology Data Net. Vol. 3. Nos. 1-4. 1-30.

Hoover, J.J. and K.J. Killgore. 1996. Impacts of Mississippi Delta flood control project on fish habitat. Appendix to EIS, Mississippi River and Tributaries Project, Mississippi Delta Project. U.S. Army Engineer District, Vicksburg.

Hoover, J.J. and K.J. Killgore. 1998. Fish Communities. Pages 237-260. *In*, M.G. Messina and W.H. Conner (eds.), Southern forested wetlands ecology and management, Lewis Publishers, New York.

Hove, M.C. 1995. Suitable hosts of the lilliput, *Toxolasma parvus*. Triannual Unionid Report 8:9. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Hove, M.C., R.A. Engelking, M.E. Peteler, and E.M. Peterson. 1995. *Anodontoides ferussacianus* and *anodonta imbecillis* host suitability tests. Triannual Unionid Report 6:22. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Hove, M.C., R.A. Engelking, M.E. Peteler, and L. Sovell. 1994. Life history research on *Ligumia recta* and *Lasmigona costata*. Triannual Unionid Report 4:23. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Hrabik, R.A. 1994. A synopsis of the effects of the 1993 flood on the biota of the open Mississippi River near Cape Girardeau.

Jenkinson, J.J. and S.A. Ahlstedt. 1993-1994. A search for additional populations of *Potamilus capax* in the St. Francis and Cache River watersheds, Arkansas and Missouri, U.S.A. *Walkerana* 7(17/18): 71-157.

Jenkinson, J.J. and S.A. Ahlstedt. 1987. A search for additional populatons of *Potamilus capax* in the St. Francis and Cache River watersheds, Arkansas and Missouri. Final Report.

Tennessee Valley Authority, Office of Natural Resources and Economic Development, Knoxville, Tennessee 37902. Prepared for the Memphis District, U.S. Army Corps of Engineers. 104 pp. w/appendices.

Johnson, T.R. 1997. The amphibians and reptiles of Missouri. Missouri Department of Conservation, Jefferson City. 369 pp.

Jones, K.H. 1997. Population survey of the interior least tern on the Mississippi River from Cape Girardeau to Vicksburg, Mississippi. Prepared for the U.S. Army Corps of Engineers, Memphis District. 15 pp.+appendix.

Junk, W.J., P.B. Bayley and R.E. Sparks. 1989. The flood pulse concept in river-floodplain systems. 110-127 pp. *In* D.P. Dodge (ed.), Proceedings of the International Large River Symposium. Can. Spec. Publ. Fish. Aquat. Sci. 106.

Karr, J.R., and I.J. Schlosser. 1978. Water resources and the land-water interface. *Science* 201:229-234.

Killgore, K.J. and J.J. Hoover. 1996. Impacts of Yazoo backwater reformulation project on fish habitat. Draft Appendix on EIS, Mississippi River and Tributaries Project, Mississippi Delta Project. U.S. Army Engineer District, Vicksburg.

Killgore, K.J. and J.J. Hoover. 1998. Impacts of St. Johns Bayou-New Madrid Floodway flood control project on fishes. 28 pp.

Korschgen, L.J. and D.L. Moyle. 1955. Food habits of the bullfrog in central Missouri farm ponds. *American Midland Naturalist* 54(2):332-341.

Korschgen, L.J. and D.L. Moyle. 1963. Foods of impoundment-and stream-dwelling bullfrogs in Missouri. *Herpetology* 19(2):89-99.

Kurth, J.E. and M.C. Hove. 1997. Host fish suitability studies and host attracting behaviors of *Tritogonia verrucosa*, the pistolgrip. Triannual Unionid Report 12:10. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Lambou, V.W. 1962. Comments on proposed dam on Old River, Batchelor, La. Louisiana Wildlife and Fisheries Commission. 37 pp.

Lambou, V.W. 1990. Importance of bottomland hardwood forest zones to fishes and fisheries: the Atchafalaya basin, a case history. Pages 125-193. *In,* J.G. Gosselink, L.C. Lee, and T.A. Muir, (eds.), Ecological Processes and Cumulative Impacts: Illustrated by bottomland hardwood wetland ecosystems.

Luo, M. 1994. Host fishes of four species of freshwater mussels, and development of an immune response. Triannual Unionid Report 3:24. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Luckey, R.R. 1985. Water resources of the southeast lowlands, Missouri. Water Investigations Report 84-4277. U.S. Geological Survey, Rolla, Missouri. 78 pp.

Maki, T.E., A.J. Weber, D.W. Hazel, S.C. Hunter, B.T. Hyberg, D.M. Flinchum, J.P. Lollis, J.B. Rognstad and J.D. Gregory. 1980. Effects of stream channelization on bottomland and swamp forest ecosystems. Water Resources Research Institute, University of North Carolina, Raleigh, North Carolina. 135 pp.

Marzolf, G.R. 1978. The potential effects of clearing and snagging on stream ecosystems. U.S. Fish and Wildlife Service, FWS/OBS-78/14, Washington D.C.

MDC. 1989. Missouri Department of Conservation wetlands management plan. Missouri Department of Conservation, Jefferson City, Missouri. 157 pp.

MDC. 1997. Fisheries Research Database, Missouri Department of Conservation, Jefferson City, Missouri.

MDC. 1999. Natural heritage database: Mississippi and New Madrid counties. Missouri Department of Conservation, Jefferson City, Missouri..

MDNR. 1997. Checklist of Plant and Animals of Big Oak Tree State Park. Missouri Department of Natural Resources.

Momot, W.T., H. Gowing, and P.T. Jones. 1978. The dynamics of crayfish and their role in ecosystems. *American Midland Naturalist* 99(1):10-35.

National Research Council. 1992. Restoration of aquatic ecosystems: science, technology, and public policy. National Academy Press, Washington, D.C.. 552 pp.

Neves, R.J. 1993. A state-of-the-unionids address. Pages 1-10. *In* K.S. Cummings, A.C. Buchanan, and L.M. Kock (eds.), Conservation and management of freshwater mussels.

Nichols, J.D., K.J. Reinecke and J.E. Hines. 1983. Factors affecting the distribution of mallards wintering in the Mississippi Alluvial Valley. *Auk* 100:932-946.

Oesch, R.D. 1995. Missouri naiades. Missouri Department of Conservation, Jefferson City. 271 pp.

Pflieger, W.L. 1997. Fishes of Missouri. Missouri Department of Conservation, Jefferson City. 372 pp.

Poff, N.L., J.D. Allen, M.B. Bain, J/R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks and J.C. Stromberg. 1997. The natural flow regime. *BioScience Vol. 47 No. 11:769-784.*

Reed, B.C. and M.S. Ewing. 1993. Status and distribution of pallid sturgeon at the Old River Control Complex, Louisiana. 54 pp.

Reinecke, K.J., J.D. Moorhead, J.D. Hodges, and J.R. Nasser. 1989. Mississippi Alluvial Valley. Pages 203-247. *In* L.M. Smith, R.L. Pederson, and R.M. Kaminski (eds.), Habitat management for migrating and wintering waterfowl in North America. Texas Tech Univ. Press, Lubbock.

Risotto, S.P. and R.E. Turner. 1985. Annual fluctuation in abundance of the commercial fisheries of the Mississippi River and tributaries. *North American Journal of Fisheries Management* 5:557-574.

Robbins, C.S., D.K. Dawson and B.A. Dowell. 1989. Habitat are requirements of breeding forests birds of the Middle Atlantic States. *Wildlife Monographs* 103:1-34.

Roberts, A.D., A.P. Farnsworth and J. Sternburg. 1997. A search for fat pocketbooks, *Potamilus capax*, in southeast Missouri. Internal Report, Missouri Department of Conservation, Natural History Section.

Sabo, M.J. and W.E. Kelso. 1991. Relationship between morphometry of excavated floodplain ponds along the Mississippi River and their use as fish nurseries. Transactions of the American Fisheries Society 120:552-561.

Sheehan, R., R.C. Heidinger, P.S. Wills, M.N. Alarcon and M.A. Schmidt. 1998. St. Johns basin and New Madrid Floodway fisheries survey: final report. 39 pp.

Stern, D.H. and M.S. Stern. 1980. Effects of bank stabilization on the physical and chemical characteristics of streams and small rivers: a synthesis. U.S. Fish and Wildlife Service Biological Report, FWS/OBS-80/11. 42 pp.

Taylor, J.R., M.A. Cardamone and W.J. Mitsch. 1990. Bottomland hardwood forests: their functions and values. Pages 13-86. *In*, J. Gosselink, L.C. Lee, and T.A. Muir, (eds.), Ecological Processes and Cumulative Impacts: Illustrated by bottomland hardwood wetland ecosystems.

Turner, T.F., J.C. Trexler, G.L. Miller and K.E. Toyer. 1994. Temporal and spatial dynamics of larval and juvenile fish abundance in a temperate floodplain river. *Copeia* (1):174-183 pp.

U.S. Army Corps of Engineers. 1980. St. Johns Bayou and New Madrid Floodway, Missouri. Phase I General Design Memorandum and Environmental Impact Statement, Volume 1. Memphis District, Corps of Engineers, Memphis, Tennessee. 145 pp. + appendices.

U.S. Army Corps of Engineers. 1997. St. Johns Bayou and New Madrid Floodway Missouri, First Phase, Draft Limited Reevaluation Report.

U.S. Army Corps of Engineers. 1998. Mississippi River mainline levees enlargement and seepage control, Cape Girardeau, Missouri to Head of Passes, LA, Project Report and Supplemental Environmental Impact Statement, Volume 1. 44 pp. and appendices.

U.S. Fish and Wildlife Service. 1981. *Federal Register.* Volume 46, No. 15, January 23.

U.S. Fish and Wildlife Service. 1989. A recovery plan for the fat pocketbook pearly mussel, *Potamilus capax* (Green 1832). U.S. Fish and Wildlife Service. Atlanta, Georgia. 22 pp.

U.S. Fish and Wildlife Service. 1980. Habitat suitability procedures. U.S. Fish and Wildlife Services, Division of Ecological Services, Washington D.C. Ecological Services Manual 102.

U.S.G.S. 1991-1996. Long-term Resources Monitoring Station data base: Open river samples near Cape Girardeau. Environmental Management Technical Center http:\\www.emtc.nbs.gov\.

Watters, T.G. 1994. An annotated bibliography of the reproduction and propagation of the Unionoidia (Primarily in North America). Ohio Biological Survey Miscellaneous Contributions No. 1. 158 pp.

Watters, G.T. 1996. New hosts for *Lampsilis cardium*. Triannual Unionid Report 9:8. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Watters, G.T. and S.H. O'Dee. 1997a. Identification of potential host: *Elliptio fisheriana* (Lea 1838), *Fusconaia masoni* (Conrad 1834), *Fusconaia flava* (Rafinesque 1820), and *Pleurobema clava* (Lamark 1819). Triannual Unionid Report 12:38. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Watters, G.T. and S.H. O'Dee. 1997b. Potential hosts for *Lampsilis radiata luteola* (Lamark, 1819). Triannual Unionid Report 12:6. Available from: U.S. Fish and Wildlife Service, Asheville, North Carolina.

Weiss, J.L. and J.B. Layzer. 1995. Infestations of glochidia on fishes in the Barren River, Kentucky. *American Malacological Bulletin* 11(2):153-159.

Welcomme, R.L. 1979. Fisheries ecology of floodplain rivers. Longman, Inc., New York. 317 pp.

Wharton, C.H., W.M. Kitchens and T.W. Sipe. 1982. The ecology of bottomland hardwood swamps of the southeast: a community profile. Fish and Wildlife Ecological Services Biological Report FWS/OBS-81/37. 133 pp.

Williams, J.D., M.L. Warren, K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries* 18(9): 6-22.

FISHES, FRESHWATER MUSSELS

AND

THEIR HOST/PARASITE RELATIONSHIPS

IN THE PROJECT AREA

Appendix A

Table A-1. Fishes collected from the St. Johns Bayou Basin and New Madrid Floodway

Ichthyomyzon castaneus	chestnut lamprey				x
Scaphirhynchus albus	pallid sturgeon	EF			x
Scaphirhynchus platorynchus	shovelnose sturgeon				x
Polyodon spathula	paddlefish	WL		x	x
Lepisosteus oculatus	spotted gar		x	x	x
Lepisosteus osseus	longnose gar		x		x
Lepisosteus platostomus	shortnose gar		x	x	x
Lepisosteus spatula	alligator gar				x
Amia calva	bowfin		x	x	x
Anguilla rostrata	American eel		x		x
Alosa chrysochloris	skipjack herring		x		x
Dorosoma cepedianum	gizzard shad		x	x	x
Dorosoma petenense	threadfin shad		x	x	x
Hiodon alosoides	goldeye		x	x	x
Hiodon tergisus	mooneye	R	x		x
Esox americanus	grass pickerel		x		
Esox lucius	chain pickeral		x		
Esox masquinongy	muskellunge				x
Campostoma pullum	central stoneroller				x

Table A- 1 (Cont'd.). Fishes collected from the St. Johns Bayou Basin and New Madrid Floodway and the Mississippi River.

Scientific Name	Common Name	Status	SJ	NM	M
Carassius auratus	goldfish		x	x	x
Ctenopharyngodon idella	grass carp		x		x
Cyprinella lutrensis	red shiner		x	x	x
Cyprinella spiloptera	spotfin shiner		x		
Cyprinella venustas	blacktail shiner		x	x	x
Cyprinus carpio	common carp		x	x	x
Erimyzon sucetta	lake chubsucker	R	x		x
Hybognathus nuchalis	Mississippi silvery minnow	WL	x		x
Hybognathus placitus	plains minnow		x		x
Hypophthalmichthys nobilis	bighead carp			x	x
Lythrurus fumeus	ribbon shiner		x	x	
Macrhybopsis aestivalis	speckled chub		x	x	
Macrhybopsis meeki	sicklefin chub	E, CF			x
Macrhybopsis storeriana	silver chub		x		x
Notemigonus crysoleucas	golden shiner		x	x	x
Notropis atherinoides	emerald shiner		x	x	x
Notropis blennius	river shiner		x	x	x
Notropis boops	bigeye shiner		x		x
Notropis chalybaeus	ironcolor shiner	WL	x		
Notropis hudsonius	spottail shiner				x
Notropis nubilus	Ozark minnow				x
Notropis texanus	weed shiner		x	x	x
Notropis volucellus	mimic shiner		x	x	x
Notropis wickliffi	channel shiner			x	x
Notropis shumardi	silverband shiner			x	x
Opsopoeodus emiliae	pugnose minnow		x	x	x
Platygobio gracilis	flathead chub	E			x
Pimephales promelas	fathead shiner				x
Pimephales notatus	bluntnose minnow		x	x	x
Pimephales vigilax	bullhead minnow		x	x	x
Semotilus atromaculatus	creek chub				x
Catostomidae	**Sucker family**				
Carpiodes carpio	river carpsucker		x	x	x
Carpiodes cyprinus	quillback		x		x

Table A- 1 (Cont'd.). Fishes collected from the St. Johns Bayou Basin and New Madrid Floodway and the Mississippi River.

Scientific Name	Common Name	Status	SJ	NM	M
Cycleptus elongatus	blue sucker	WL	x		x
Erimyzon sucetta	lake chubsucker	R	x		
Ictiobus bubalus	smallmouth buffalo		x	x	x
Ictiobus cyprinellus	bigmouth buffalo		x	x	x
Ictiobus niger	black buffalo		x	x	x
Minytrema melanops	spotted sucker		x		x
Moxostoma carinatum	river redhorse			x	x
Moxostoma erythrurum	golden redhorse		x		x
Moxostoma macrolepidotum	shorthead redhorse				x
Ictaluridae	**Catfish family**				
Ameiurus melas	black bullhead		x	x	x
Ameiurus natalis	yellow bullhead		x	x	x
Ictalurus furcatus	blue catfish			x	x
Ictalurus punctatus	channel catfish		x	x	x
Noturus flavus	stonecat				
Noturus gyrinus	tadpole madtom		x	x	
Noturus nocturnus	freckled madtom		x		x
Pylodictis olivaris	flathead catfish		x	x	x
Aphredoderidae	**Pirate Perch Family**				
Aphredoderus sayanus	pirate perch		x		x
Cyprinodontidae	**Topminnow Family**				
Fundulus chrysotus	golden topminnow	EXT	x		
Fundulus dispar	starhead topminnow	WL	x		
Fundulus notatus	blackstripe topminnow		x	x	x
Fundulus olivaceus	blackspotted topminnow		x	x	x
Poeciliidae	**Livebearer Family**				
Gambusia affinis	mosquitofish		x	x	x
Atherinidae	**Silverside Family**				
Labidesthes sicculus	brook silverside		x	x	x
Menidia beryllina	inland silverside			x	x

Table A- 1 (Cont'd.). Fishes collected from the St. Johns Bayou Basin and New Madrid Floodway and the Mississippi River.

Scientific Name	Common Name	Status	SJ	NM	M
Percichthyidae	**Bass Family**				
Morone saxatilis	striped bass				x
Morone mississippiensis	yellow bass			x	x
Morone chrysops	white bass		x	x	
Centrarchidae	**Sunfish Family**				
Ambloplites ariommus	shadow bass		x		
Centrarchus macropterus	flier	WL	x	x	x
Lepomis cyanellus	green sunfish		x	x	x
Lepomis gulosus	warmouth		x	x	x
Lepomis humilis	orangespotted sunfish		x	x	x
Lepomis macrochirus	bluegill		x	x	x
Lepomis megalotis	longear sunfish		x	x	x
Lepomis microlophus	redear sunfish		x		x
Lepomis miniatus	redspotted sunfish		x	x	
Lepomis symmetricus	bantam sunfish			x	
Micropterus punctulatus	spotted bass		x	x	x
Micropterus salmoides	largemouth bass		x	x	x
Micropterus dolomieu	smallmouth bass				x
Pomoxis annularis	white crappie		x	x	x
Pomoxis nigromaculatus	black crappie		x	x	x
Elassomatidae	**Pygmy Sunfish Family**				
Elassoma zonatum	banded pygmy sunfish		x		
Percidae	**Perch Family**				
Ammocrypta clara	western sand darter				
Etheostoma asprigene	mud darter		x	x	x
Etheostoma chlorosomum	bluntnose darter		x	x	x
Etheostoma gracile	slough darter		x	x	x
Etheostoma histrio	harlequin darter	ES	x		x
Etheostoma microptera	least darter	WL	x		
Etheostoma nigrum	Johnny darter				x
Etheostoma proeliare	cypress darter		x	x	
Percina caprodes	logperch		x		x

Table A-1(Cont'd.). Fishes collected from the St. Johns Bayou Basin and New Madrid Floodway and the Mississippi River.

Scientific Name	Common Name	Status	SJ	NM	M
Percina maculata	blackside darter		x		
Percina phoxocephala	slenderhead darter				
Percina sciera	dusky darter		x		x
Percina shumardi	river darter	WL			x
Percina vigil	saddleback darter		x		
Stizostedion canadense	sauger		x	x	x
Stizostedion vitreum	walleye		x		x
Sciaenidae	**Drum Family**				
Aplodinotus grunniens	freshwater drum		x	x	x
Mugilidae	**Mullet Family**				
Mugil cephalus	striped mullet				x

Sources: Sheehan et al. (1998), MDC (1997a), Pfleiger (1997), U.S.G.S. (1991-1996).

Status codes: WL = Missouri Watch List
R = Missouri Rare
EXT = Extirpated from Missouri
ES = Missouri Endangered
CF =Candidate for Federal Listing
EF = Federally endangered

Locations: SJ = St. Johns Basin
NM =New Madrid Floodway
M = Mississippi River

Table A-2. Scientific and common names, status, and general location of freshwater mussels found in the St. Johns and New Madrid basins.

Scientific Name	Common Name	Status	SJ	Sb	Sja	NM	O
Amblema plicata	three-ridge		x	x	x	x	
Anodonta suborbiculata	flat floater	R			x	x	
Arcidens confragosus	rock pocketbook	R		x	x	x	
Corbicula fluminea	Asiatic clam		x	x	x	x	
Fusconaia flava	Wabash pig-toe			x			
Lampsilis siliquoidea	fat mucket				x		
Lampsilis cardium	plain pocketbook		x	x	x		
Lampsilis teres	yellow sandshell		x	x	x		x
Lasmigona complanata	white heel-splitter		x	x	x	x	
Leptodea fragilis	fragile paper shell		x	x	x	x	x
Ligumia subrostrata	pond mussel				x		
Obliquaria reflexa	three-horn warty-back					x	
Potamilus alatus	pink heel-splitter						x
Potamilus ohiensis	pink paper shell					x	x
Potamilus purpuratus	bluefer		x	x	x	x	x
Pyganodon g. grandis	giant floater		x	x	x	x	x
Quadrula nodulata	warty-back	R			x	x	
Quadrula quadrula	maple leaf		x	x	x	x	x
Quadrula pustulosa	pimple-back		x	x		x	
Toxolasma texasensis	Texas lilliput	R			x		
Toxolasma parvus	lilliput				x		
Tritogonia verrucosa	pistol-grip		x	x		x	
Truncilla truncata	deer-toe			x			
Uniomerus tetralasmus	pond horn			x			
Utterbackia imbecillis	paper floater				x	x	

Sources: Barnhart (1998)

Status codes: WL = Missouri Watch List
R = Missouri Rare
ES = Missouri Endangered

Locations: SJ = St. Johns Ditch
Sb = Setback levee Ditch
Sja = St. James Ditch
NM = New Madrid Floodway
O = St. Johns Outlet Ditch
(below flood gate)

Table A-3. Reported fish hosts of unionids that coexist in the project area. Potential fish hosts have either been identified by successful laboratory transformations (no evidence that the fish species actually encounters the mussel in nature) or by observation of encysted glochidia in the field (no evidence that glochidial transformation actually occured). Confirmed fish hosts are supported by both types of evidence.

Species	Confirmed fish hosts	Potential fish hosts
Amblema plicata threeridge	largemouth bass	black crappie, bluegill, flathead catfish, green sunfish, sauger, shortnose gar, white bass, white crappie, yellow perch
Anodonta suborbiculata flat floater	golden shiner, largemouth bass warmouth, white crappie	brooksilverside, bluegill, freshwater drum, gizzard shad, mosquitofish, orangespotted sunfish
Arcidens confragosus rock pocketbook	unknown	American eel, freshwater drum, gizzard shad, white crappie
Fusconaia flava Wabash pig-toe	unknown	black crappie, bluegill, white crappie, creek chub
Lampsilis siliquoidea fat mucket	bluegill, largemouth bass, walleye	black crappie, bluntnose minnow, common shiner, longear sunfish, orangespotted sunfish, pumpkinseed, sauger, smallmouth bass, striped shiner, white crappie
Lampsilis cardium plain pocketbook	white crappie	bluegill, green sunfish, largemouth bass, sauger, smallmouth bass, walleye
Lampsilis teres yellow sandshell	alligator gar, largemouth bass, longnose gar, shortnose gar	black crappie, green sunfish, orangespotted sunfish, shovelnose sturgeon, warmouth, white crappie

Table A-3 (Con't.) Reported fish hosts of unionids that coexist in the project area. Potential fish hosts have either been identified by successful laboratory transformations (no evidence that the fish species actually encounters the mussel in nature) or by observation of encysted glochidia in the field (no evidence that glochidial transformation actually occured). Confirmed fish hosts are supported by both types of evidence.

Species	Confirmed fish hosts	Potential fish hosts
Lasmigona complanata white heel-splitter	unknown	carp, green sunfish, largemouth bass, orangespotted sunfish, white crappie
Leptodea fragilis fragile paper shell	unknown	freshwater drum
Ligumia subrostrata pond mussel	unknown	bluegill, green sunfish, orangespotted sunfish, warmouth
Obliquaria reflexa threehorn wartyback	unknown	unknown
Potamilus alatus pink heelsplitter	unknown	freshwater drum
Potamilus ohiensis pink papershell	freshwater drum	white crappie
Potamilus purpuratus bleufer	freshwater drum	
Pyganodon g. grandis giant floater	black crappie, bluegill, bluntnose minnow, brook silverside, central stoneroller, common shiner, green sunfish, johnny darter, largemouth bass	carp, creek chub, freshwater drum, gizzard shad, golden shiner, golden topminnow, longear sunfish, longnose gar, orangespotted sunfish, redfin shiner, river carpsucker, skipjack herring, white bass, white crappie, yellow bullhead

Table A-3 (Con't.) **Reported fish hosts of unionids that coexist in the project area. Potential fish hosts have either been identified by successful laboratory transformations (no evidence that the fish species actually encounters the mussel in nature) or by observation of encysted glochidia in the field (no evidence that glochidial transformation actually occured). Confirmed fish hosts are supported by both types of evidence.**

Species	Confirmed fish hosts	Potential fish hosts
Quadrula nodulata wartyback	unknown	black crappie, bluegill, channel catfish, largemouth bass, white crappie
Quadrula quadrula mapleleaf	unknown	flathead catfish
Quadrula pustulosa pimpleback	black bullhead, channel catfish, flathead catfish	brown bullhead, shovelnose sturgeon, white crappie
Toxolasma texasensis Texas lilliput	unknown	bluegill, warmouth
Toxolasma parvus lilliput	greensunfish	bluegill, orangespotted sunfish, warmouth white crappie
Tritogonia verrucosa pistolgrip	unknown	yellow bullhead, flathead catfish
Truncilla truncata deertoe	unknown	freshwater drum, sauger
Uniomerus tetralasmus pondhorn	unknown	golden shiner
Utterbackia imbecillis paper pondshell	bluegill	black crappie, creek chub, green sunfish, largemouth bass, longeared sunfish, spotfin shiner, warmouth, western mosquitofish

Table A-3 (Con't.) Reported fish hosts of unionids that coexist in the project area. Potential fish hosts have either been identified by successful laboratory transformations (no evidence that the fish species actually encounters the mussel in nature) or by observation of encysted glochidia in the field (no evidence that glochidial transformation actually occured). Confirmed fish hosts are supported by both types of evidence.

Species	Confirmed fish hosts	Potential fish hosts

Sources: Kurth and Hove 1997, Watters et al. 1997a, Watters et al. 1997b, Barnhart et al. 1996, Watters 1996, Hove 1995, Hove et al. 1995, Weiss and Layzer 1995, Hove et al. 1994, Luo 1994, Watters 1994, Hoggarth 1992,

WATERFOWL ASSESSMENT METHODOLOGY

St. Johns Bayou and New Madrid Floodway

Project

East Prairie Phase

Appendix B

U.S. Fish and Wildlife Service
Missouri Field Office
Columbia, Missouri

June 1998

EXECUTIVE SUMMARY

This section summarizes the findings of the U.S. Fish and Wildlife Service's Draft Waterfowl Technical Appendix (appendix) associated with the Memphis District, Army Corps of Engineers' (Corps) St. Johns Bayou and New Madrid Floodway, Missouri Project, First Phase. The Service understands that this appendix is to become an integral part of the environmental report.

The Service has identified habitat loss and degradation as the major waterfowl management problem in North America. Because of the loss of migratory waterfowl breeding and wintering habitat, continental waterfowl breeding populations are below long term averages. The primary purpose of this appendix is to quantify the impacts of the St. Johns Bayou and New Madrid Floodway Project, First Phase, on wintering waterfowl carrying capacity and foraging habitat in the project area.

The Waterfowl Assessment Methodology (WAM) uses hydrologic and land use data for future with- and future without-project conditions to compare impacts on wintering waterfowl carrying capacity due to the proposed project. The WAM is based on food as an index for the carrying-capacity of wintering waterfowl and is expressed in terms of duck-use-days (DUDs). This methodology was modified from waterfowl appendices for other flood control projects to account for the effects of seed consumption and decomposition. Project impacts on the length and extent of average seasonal acres flooded during the 151-day wintering period from November 1 to March 31 were also identified. Additionally, this appendix contains measures to compensate for unavoidable losses of duck-use-days. Conceptual in nature, the measures rely primarily on the acquisition, reforestation, and intense management of frequently flooded land as wintering waterfowl habitat.

In the project area, waterfowl are present throughout the year. The species present, the life functions they engage in and the habitats the require vary with the seasons. The proposed project will affect all those species, life functions and needed habitat to some degree. Some benefits will occur, but far more detrimental effects will be realized. During late spring and summer, wood duck broods, and to a lesser degree, mallards, hooded mergansers and blue-wing teal are raised. Earliest fall migrations of waterfowl occur in mid August when the first flocks of blue-wing teal arrive. Fall migration continues through late December and even early January as more winter hardy species finally make their way south. Fall/winter migration has barely concluded before early migrants leave southeast Missouri for locations to the north. Migration is a slow, drawn-out process during which waterfowl require feeding and resting habitat. Wintering may occur at various latitudes and is dictated by habitat availability and freeze up. Spring migration is concluded by mid-March as the last of the shovelers and blue-wing teal depart. Historically, the project area has provided habitat for all those life functions and must continue to do so in the future.

Implementation of the proposed flood control project would greatly alter the availability of habitat for wintering and migrating waterfowl. One negative impact will be the loss of flooding diversity. Flood timing, duration and depth will be controlled through the pump operating plan, removing natural variability which contributes to the overall health and stability of wetland ecosystems. Although both the Authorized Project and the Avoid and Minimize (A&M) alternatives would produce a net increase in potential total annual duck-use days (DUDs), those gains would appear in December and January, rather than February and March. In the St. Johns Bayou basin, the Authorized Project alternative would increase total DUDs by 464,906 while greatly reducing waterfowl use by 74,390 DUDs in February and March, during spring migration. The A&M alternative for that basin is expected to increase total DUDs by 545,856 primarily because of increased moist soil and soybean acreage. That alternative, however, would also provide important bottomland habitat during spring migration. In the New Madrid Floodway, the Authorized Project would increase the total seasonal DUDs by 50,140 while reducing February and March usage by 225,822 DUDs; a pattern similar to that seen in the St. Johns basin. The A&M alternative would also result in an increase of 53,374 total DUDs, while greatly decreasing late winter/early spring usage by 222,588 DUDs. Under both those alternatives, moist soil and BLH acreage flooded during spring migration would be significantly lower, reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988).

Increased DUDs indicated by WAM during December and January for both basins are the result of ponding in the sump as specified by the operational plan. Those potential gains, however, are very questionable. Traditional use of wintering waterfowl habitats in southeast Missouri is closely linked to the relative wetness (i.e., rainfall) within the regions during late October through January (Bellrose and Crompton 1970, Nichols et al. 1983). Forty-nine hundred acres of ponded water in an otherwise dry St. Johns basin and New Madrid Floodway is an extremely small tract of habitat to migrating waterfowl. For example, over the last several years, the Eagles Nest Wetland Reserve Program tract and rice fields on Hunter Farms have been annually flooded using pumps during fall and winter for hunting. Those habitats, however, receive significantly less waterfowl use in dry years than in years when the region is wet (D. Wissehr and B. Allen, MDC, per. comm.). In light of the above, we strongly recommend that the operational plan be altered to allow for the greatest possible diversity of flood timing, durations and depth during November through March. We believe such a plan will realize more benefits to waterfowl, as well as other species. Under the proposed alternatives, bottomland hardwoods in the sump area would be flooded annually to great depths for extended periods. Such inundation is detrimental to bottomland hardwood species (Fredrickson and Batema 1992) and could undermine their long-term survival. Altering the operational plan would also allow the river to ebb and flow into both basins during that time, greatly benefitting fisheries resources by maintaining connectivity between the river and its floodplain.

It is important to note that WAM does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, per. comm.). During that time, waterfowl are forming pairs, molting and preparing to breed (Heitmeyer 1985). Furthermore, the WAM does not consider other forested wetland habitat components necessary for healthy waterfowl populations. Forested wetlands fulfill special waterfowl habitat requirements not found in open land (i.e., moist soil units and cropland) (Fredrickson and Heitmeyer 1988). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Both project alternatives would eliminate backwater flooding on thousands of acres of forested wetlands and moist soil areas during spring migration, significantly reducing habitat that provides necessary protein sources particularly important to waterfowl at that time of year. Under existing conditions, those waterfowl acres occur during spring flooding and are distributed over up to 75,000 acres. Such a large distribution is a critical factor for waterfowl, especially as they form breeding pairs. Because of the differing seasonal habitat requirements of waterfowl, potential fall migration and winter habitat benefits do not replace significant spring migration habitat losses that would occur with either project alternative.

The project will eliminate overflow flooding over thousands of acres within the project area. Upon receding, those floodwaters produce numerous shallow, temporarily flooded wetlands in a variety of cover types. Depending on the timing of such flooding, fall migration, over-wintering, or spring migration habitat is created. A variety of waterfowl, not to mention other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Significant alterations in the extent and timing of seasonal flooding in the project area concern the Service not only because of the potential adverse impacts upon migratory waterfowl, a federal trust resource, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

This Waterfowl Technical Appendix (appendix) is submitted in partial fulfillment of the Fiscal Year 1998 scope of work for U.S. Fish and Wildlife Service activities pertaining to the Army Corps of Engineers (Corps), Memphis District, Supplemental Environmental Impact Statement on the St. Johns Bayou and New Madrid Floodway, Missouri Project, First Phase. The purpose of this appendix is threefold: first, to identify the relative importance of the general project area in terms of historic trends in wetlands and wintering waterfowl, primarily mallards (*Anas platyrhychos*); secondly, to document existing wintering waterfowl carrying capacity in the project area, and thirdly, to document project impacts to existing conditions using food as an index of carrying capacity expressed in terms of duck-use-days. It is important to note that this methodology focuses on waterfowl energetics; it *does not* quantify other habitat values (e.g., cover, pair-formation, brood rearing, etc.) important in maintaining healthy waterfowl populations.

The information contained in this appendix is submitted in accordance with the referenced scope of work and with provisions of the Fish and Wildlife Coordination Act, but does not constitute the final report of the Department of Interior, U.S. Fish and Wildlife Service, as required by Section 2(b) of the Act.

PROJECT DESCRIPTION

The St. Johns Bayou and New Madrid Flood way Project, authorized by the Water Resources Development Act of 1986, originally included 130 miles of channel improvements, two pump stations, and environmental mitigation features. The purpose of the currently proposed work, the East Prairie Phase, is to develop the economy and infrastructure in the project area (U.S. Army Corps of Engineers 1997). This Phase includes vegetative clearing along 4.3 miles of rural channels and enlarging 23.4 miles of rural channels in the St. Johns basin. The project also includes a 1,000 cubic-foot-per second (cfs) pump station in St Johns basin, and a 1,500 cfs pump station in the New Madrid Floodway. Additional work, authorized by the Flood Control Act of 1954, includes closing and installing a gravity drainage structure in the existing 1500-foot opening at the southern end of the New Madrid Floodway. The proposed project is expected to provide a 2-year level of flood protection in the area of East Prairie, and a 1.1-year level of flood protection to primarily agricultural land in the floodway.

PROJECT ALTERNATIVES

The Corps is evaluating two project alternatives to determine which of those plans would achieve the project purpose and have the least impact on fish and wildlife resources. Those alternative plans are the Authorized Project, as described above, and an Avoid and Minimize (A&M) alternative. Under the A&M alternative, channel widening in St. Johns Bayou would be reduced, pump operations would allow higher (than authorized) winter water sump levels in both basins, and bank work would be restricted to one side of the channel to minimize impacts to riparian corridors.

HISTORICAL PERSPECTIVE OF WETLANDS AND WATERFOWL IN THE MAV

Wetlands

Before settlement by European and Africans, the Mississippi River floodplain was an intricate maze of bottomland hardwood forests, swamps, oxbows, and bayous. Historically, this area was covered by 24 million acres of bottomland forest, the largest forested wetland in North America. Most of the Mississippi River Alluvial Valley (MAV) was subject to periodic flooding by the Mississippi River and its tributaries, providing invaluable habitat for fish and wildlife. The transformation of this vast forest into agriculture use was gradual, yet deliberate. Federally funded water resource development projects for flood control and agriculture drainage drastically changed the hydrologic relationship between the floodplain and the river, essentially eliminating seasonal interchange.

In the mid-1800's, Congress enacted a series of Swamplands Acts that deeded more than 20 million acres of swamplands to the states. With the proceeds from the sale of these lands being used for reclamation, wetlands were cleared, drained, and converted to agriculture use. Extensive settlement of the MAV occurred by 1900. As the result of devastating floods (1912, 1913, 1916, and 1927), Congress enacted the comprehensive flood protection program called the Mississippi River and Tributaries Project (MR&T). MR&T Project includes 1,500 miles of mainline levees along both banks of the Mississippi River that provide flood protection to 15 million acres. As a direct result of that project, millions of acres of bottomland hardwood forests were cleared for agricultural production (U.S. Department of the Interior 1988).

Over the last two decades, however, the nation has begun to appreciate the critical functions forested wetlands provide to fish, wildlife, and humans (e.g., improve water quality, store storm water, reduce flood stages, etc.). To reverse historic wetlands losses, Congress enacted legislation, such as the Clean Water Act, to protect remaining wetlands. Additional legislation that also encourages wetland restoration includes the 1985 Farm Bill, the Emergency Wetlands Protection Act of 1986, the Water Resources Development Act of 1986, the Agriculture Credit Act of 1987, the Conservation Reserve Program, the 1990 Farm Bill, the Food Security Act of 1992, the Wetlands Reserve Program (WRP), and the Federal Agriculture Improvement and Reform Act of 1996. For example, under the provisions of WRP, the federal government pays land owners fair market value for marginal cropland (formerly wetlands) and assists in replanting these areas in bottomland hardwood species. Within the project area approximately 1,024 acres are enrolled in the WRP.

Waterfowl

Historically, the MAV served as a major wintering area for waterfowl. Waterfowl population numbers began to decline in the 1960's as the direct result of extensive droughts and loss of nesting habitat in the prairie pothole region of the North America and the conversion of wintering areas in the MAV (bottomland hardwoods) to agricultural production. Waste grain, rice, and soybeans are now the dominate food sources of waterfowl in the MAV. These crops are typically grown on frequently flooded cropland. Federal flood control and drainage programs have reduced these flooded areas, greatly limiting naturally flooded or ponded habitat during a significant portion of the wintering period. The net effect of wetland conversion and drainage has been that natural habitat is no longer sufficient to meet the needs of wintering and migrating waterfowl as well as other migratory birds.

The remaining wetlands in the project area, particularly the bottomland hardwoods, are very important to wintering waterfowl. Forested wetlands fulfill special waterfowl habitat requirements not found in open land. Wooded habitats produce nutritious food for waterfowl and provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Coupled with nearby state and federal wildlife refuges/conservation areas, project-area wetlands provide wintering and migration habitat to hundreds of thousands of waterfowl annually.

Waterfowl harvests have fluctuated since records have been kept, being lowest during the early 1960's when waterfowl populations, potential hunters, and days afield were low. In most years, harvests have tracked the fluctuation of these factors, especially waterfowl populations. After two years of exceptional breeding conditions, however, several species of waterfowl, including mallards, are showing signs of recovery approaching the population levels recorded in the 1950's. Two species, however, the northern pintail (*Anas acuta*) and the lesser scaup (*Aythya affinis*), remain below the long-term average. Mallards comprise the majority of the ducks harvested in Missouri, followed by gadwall, green-wing teal, and wood duck.

WINTERING WATERFOWL BIOLOGICAL CHARACTERISTICS

Habitat Availability

The loss and degradation of waterfowl habitat has been identified as the major waterfowl management problem in North America (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1986). The North American Waterfowl Management Plan (NAWMP) is an international effort to restore waterfowl populations in North America to support a fall flight of at least 100 million ducks. The project area is located in the Lower Mississippi Valley (LMV) Joint Venture - New Madrid Wetlands Project area. Southeast Missouri has been identified as wetland-deficient with only 50,000 of an original 2.5 million acres of wetlands remaining (L.H. Fredrickson, cited in MDC 1989). The NAWMP has recognized those wetlands in southeast Missouri as a critical component in the LMV Joint Venture. Habitat protection and restoration through acquisition and partnerships (e.g., the WRP) with private landowners is a priority in this area.

Habitat requirements for wintering waterfowl can be broken down into three components: availability, utilization, and suitability in meeting social behavioral requirements. Size of the migratory waterfowl population in the MAV is a direct function of these three components. Managed and unmanaged wintering waterfowl habitats are present in the MAV. Managed habitats, using structural measures and vegetation manipulation, are primarily found on Federal and state lands, and represent the core wintering habitat during dry (below normal rainfall) years.

Unmanaged winter habitat provides important foraging habitat to wintering waterfowl during years of normal or above normal rainfall. Increased availability of wintering habitat also affects the distribution of wintering waterfowl in the MAV. Proportionately more waterfowl have been found to winter in the MAV during periods of above normal rainfall and cold winters (Nichols et al. 1983, Reinecke et al. 1987). This unmanaged and flood susceptible habitat, which is so important to wintering waterfowl, has long been subject to federal flood control drainage projects in the MAV. The St. Johns Bayou and New Madrid Floodway Project is an example of a project that, as proposed, will significantly impact wintering and migration waterfowl habitat.

In recent years, research has focused on relative waterfowl utilization, and associated food availability, in natural and agricultural foraging habitat. Utilization of agricultural fields differs among crops (Nelms and Twedt in prep.). Herbaceous native vegetation is used to a greater extent than any agricultural crops. Bottomland hardwoods are utilized for foraging to a certain extent and roosting, loafing, and pair formation to a large extent (Reinecke et al. 1989). Those forests are particularly important because their invertebrate populations provide waterfowl with a critical source of protein. In late winter, waterfowl increase the invertebrate portion of their diet to prepare for spring migration to northern breeding grounds.

Habitat Utilization

Waterfowl are mobile and opportunistic, and their feeding habits have changed over time, presumably in response to the large scale conversion of native wooded wetlands to small grain agricultural crops. The principal foods of mallards generally include agricultural grains; seeds and tubers of native plants; acorns; and invertebrates such as isopods, snails, and fingernail clams (Reinecke et al. 1987). Heitmeyer (1985) and Combs (1987) found that pin oak (*Quercus palustris*) and cherrybark oak (*Quercus falcata* var. *pagodaefolia*) acorns dominate the mallard diet during years of good mast production and favorable water conditions in southeastern Missouri.

Mallards concentrate on recently flooded openings with shallow depths in bottomland forests in the early fall. Shortly after arrival, mallards complete prealternate (breeding plumage) molt and consume aquatic insects and moist soil seeds. Following molt, mallards begin courtship and by early January, 90 percent of the birds are paired (Bellrose 1980). During pairing, mallards forage intensively in flooded forests or agricultural fields, where they consume acorns and cereal grains. After pairing, mallards readily use shallowly flooded forests and continue to consume acorns, but increase consumption of macroinvertebrates (Fredrickson and Batema 1992).

Wood ducks (*Aix sponsa*) use overcup oak, cypress/tupelo forest types and scrub/shrub habitats during fall courtship and pairing (Bellrose 1980). After pairing, wintering habitat includes the deeper areas of lowland hardwoods, cypress/tupelo, overcup oak, and scrub/shrub habitats.

Wright (1961) and Delnicki and Reinecke (1986) demonstrated the importance to waterfowl of large areas of flooded rice and soybean fields. Seeds and tubers of grasses, sedges, and other moist soil plants are also important components of the diet (Wright 1961, Wills 1970, Heitmeyer 1985, Delnicki and Reinecke 1986, Combs 1987). Invertebrates generally provide less than 10 percent of the diet in agricultural (Delnicki and Reinecke 1986) and moist soil (McKenzie 1987) habitats, but may be more important in forested wetlands (Heitmeyer 1985).

Although the nutrition requirements of wintering waterfowl area not well understood, it is, however, increasingly clear that nutrition affects dietary energy and protein intake, and that meeting these dietary requirements is positively related to winters with normal or above normal rainfall. Studies conducted in Mississippi during the wet winter of 1982-83 show increased mallard body weights while the dry winter of 1980-1981 show decreased mallard body weights (Delnicke and Reinecke 1986). Similar results in Missouri indicated that mallard body weights increased when water conditions and mast production were favorable, or when rainfall was sufficient to flood low-lying cropland (Heitmeyer 1985, Combs 1987). The condition in which waterfowl return to the breeding grounds has been shown to have a major impact on their breeding success and survival (Bellrose 1980, Reinecke et al. 1989).

Social Behavior

During winter, courtship and pair formation dominate the social behavior of dabbling ducks. Most of the project area is agricultural land, replacing forested wetlands as the primary foraging habitat. The forested wetlands and associated shrub swamps, beaver ponds, riparian habitat, and other deep water habitat are used as resting or roosting areas and provide isolation from human disturbance, protection from predators, and a location for courtship and other social activities where pairs are visually isolated. Whereas much of the foraging and nutritional requirements can be met by flooded agricultural lands, a variety of habitats is needed to satisfy the total biological requirements of wintering waterfowl, because members of the population may differ in their habitat needs at any particular time (Reinecke et al. 1987). Examples include the likelihood of juvenile or unpaired mallards feeding in agricultural lands and adults and pairs seeking the isolation of shrub swamps to avoid harassment from courting parties (Heitmeyer 1985).

Project Area

In the project area, waterfowl are present throughout the year. The species present, the life functions they engage in and the habitats the require vary with the seasons. During late spring and summer, wood duck broods, and to a lesser degree, mallards, hooded mergansers and blue-wing teal are raised. Earliest fall migrations of waterfowl occur in mid-August when the first flocks of blue-wing teal arrive. Fall migration continues through late December and even early January as more winter hardy species finally make their way south. Fall/winter migration has barely concluded before early migrants leave southeast Missouri for location to the north. Migration is a slow, drawn-out process during which waterfowl require feeding and resting habitat. Wintering may occur at various latitudes and is dictated by habitat availability and freeze up. Spring migration is concluded by mid-March as the last of the shovelers and blue-wing teal depart. Historically, the project area has provided habitat for all those life functions and must continue to do so in the future.

IMPACT ASSESSMENT METHODOLOGY

In this section, the term wintering waterfowl includes primarily puddle ducks consisting of the mallard, northern pintail, American widgeon, gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), northern shoveler (*Anas clypeata*), and blue-winged teal (*Anas discors*).

Prior waterfowl appendices incorporated a methodology that used available food (energy) as an index of the carrying capacity of winter foraging habitat for dabbling ducks in the MAV. This methodology was developed in 1992 by Mr. Robert Barkley (U.S. Fish and Wildlife Service, Vicksburg Field Office) and Dr. Kenneth J. Reinecke (National Biological Service, Mississippi Valley Research Field Station). This method was used on several Corps flood control projects to quantify the impact of altering hydrology on traditional waterfowl wintering areas and for designing appropriate mitigation measures (U.S. Army Corps of Engineers 1991, 1993, 1998). This method has also been used in setting habitat management goals for wintering waterfowl habitat in the MAV (Loesch et al. 1994).

The Corps prepared a GIS data base to identify acres of available foraging habitat under existing conditions, future conditions with and without the project alternatives. Land use, hydrology, and available food during the 151 day (November 1 to March 31) waterfowl wintering period, was used to determine carrying capacity in terms of duck-use-days. The data were specific to those habitats and food resources (corn, soybeans, moist soil, bottomland hardwood forested wetlands) used by foraging waterfowl. The amount of food available on a unit area was determined by Reinecke et al. (1989) and McAbee (1994). Small grain crop residues, moist soil native weed seeds, acorns, and invertebrates in forest stands with approximately 30 percent red oaks represent the available winter waterfowl food.

For this waterfowl appendix the previously described methodology was refined to include information on seed deterioration rates and seed abundance, invertebrate abundance, as well as depth and duration of flooding (Nelms and Twedt 1996). Waterfowl foraging habitat, regardless of food value, is only of use to wintering waterfowl if available. Waterfowl use relatively shallow water areas, two feet or less, for feeding. Through the use of extensive hydrological data, the Corps provided average seasonal acres flooded 24 inches or less for the wintering season. The land use data provided for the study area were specific to those acres inundated and represent only potential available foraging habitat. By including these factors, the present methodology is more representative of winter waterfowl foraging habitat.

The index of carrying capacity for wintering waterfowl foraging habitat is now expressed in duck-use-days (DUD) per acre which represents the capacity of the available forage to meet the energy requirements of one duck for one day per acre. The information requirements to estimate DUD are: (1) current land use, including crop type, (2) extent, duration, and depth of flooding, (3) amount of winter food present by land use, (4) energy of food items, (5) deterioration rates of food items, (6) energy requirements of waterfowl, and (7) estimated density of waterfowl. The equation for this is as follows:

$$DUD/Acre = \frac{Food\ X\ Energy}{Duck\ Energy\ Needs}$$

The equation used to estimate DUD was further refined by factoring in the amount of seed deterioration that occurs over time because seed deterioration has a significant impact on DUD. Deterioration rates were estimated from experimental data using the best fitting regression model (Nelms and Twedt 1996). Daily seed consumption estimates were also incorporated into the equation to preclude overestimating the influence of seed deterioration because foods consumed by ducks are not subject to deterioration. Since DUD are a function of the weight of the food available and food is easily converted to calories, calculations are in terms of the weight of food. The equation for food available to ducks on a given day when seed consumption and deterioration are taken into account is:

$$Food_j = Food_0 - \sum_{i=0}^{j} (Food_{consumed_i} + Food_{deteriorated_i})$$

where:

$$Food_{consumed} = \frac{Mean\ duck\ density\ X\ Kcal\ \ consumed/duck/day}{Kcal/kg\ of\ food}$$

and

$$Food_{deteriorated} = Food \; X \; Deterioration \; rate \; X \; Days_i$$

where I and j are days.

Duck-use-days per acre, adjusted for deterioration, is calculated by multiplying the number of days times the projected density of ducks. By converting to DUD, units are comparable across habitats which facilitates both wetland mitigation efforts and management decisions. This is particularly useful when the loss of one habitat must be mitigated with another habitat type due to practical constraints or the need to meet multiple ecosystem management goals. DUD provide an objective index of the relative value of different habitats for dabbling ducks as winter foraging habitats.

To facilitate calculation, food item densities, deterioration rates, and energy values were aggregated within a given habitat type. Weighted averages based on weights of food items were used to calculate the aggregate values. Aggregate values are representative of any generic unit of food in the habitat of interest (Table 1).

Table 1. Food densities and metabolizable energy content of foods in the MAV

Food density in kg/ha (metabolizable energy content in Kcal/kg)[1]

Habitat	Acorns	Grain	Weeds	Invertebrates
Moist soil/ Fallow field			450 (2500)	0.69[2] (2500)
Harvested Cropland				
Corn		250 (3670)		
Soybean		86[1,2] (1871)	54[2] (2500)	0.44[2] (2500)
Bottomland Hardwoods				
30% red oaks	27 (3500)		22.5 (2500)	13.7 (2500)
50% red oaks	44 (3500)		22.5 (2500)	13.7 (2500)
70% red oaks	62 (3500)		22.5 (2500)	13.7 (2500)
90% red oaks	80 (3500)		22.5 (2500)	13.7 (2500)

[1] All information from Reinecke et al. (1989) unless otherwise indicated
[2] McAbee (1994)

Once aggregate values were calculated, the density of ducks feeding in the habitats of interest is projected so that daily consumption can be estimated. An overall average of systematic observations of waterfowl in flooded moist soil, and soybean fields in the MAV was used to estimate duck density. The estimated diurnal density of ducks in flooded soybean and moist soil fields in the MAV from data collected by McAbee (1994) and Dr. Dan Twedt (National Biological Service) and Mr. Curtis Nelms (U.S. Fish and Wildlife Service, Vicksburg) (unpublished data) is 10.1 ducks/ha. No empirical estimates of waterfowl density in flooded bottomland hardwoods (BLH) in the MAV are known to exist, so estimates from croplands and moist soil are used for BLH also. Little information is available on nocturnal feeding densities of waterfowl, although this has been shown to be an important phenomenon (Paulus 1980, Reinecke unpublished data). To adjust for nocturnal foraging, the estimate of diurnal density is doubled to 20.2 ducks/ha. The role of the projected density and subsequent consumption estimates is to dampen the effects of seed deterioration on food availability.

If the average daily consumption estimates were not included in the model, then the influence of seed deterioration would be overestimated because foods consumed by ducks are no longer subject to deterioration. From these calculations, DUD/ha and Days to Exhaustion (DTE) were generated (Table 2). (Note: Although most forested wetland tracts in the project area had less than 30 percent red oaks, personnel with the Missouri Department of Conservation determined that using similar food energy values for those stands would also take into consideration increasing invertebrate numbers towards the end of the waterfowl season.)

Table 2. Duck-use-days per acre/hectare and days to exhaustion of food resources in winter flooded moist soil, soybean, and bottomland hardwood forest.[1]

Habitat	Duck-use days per acre/hectare	Days to Exhaustion	
Moist Soil/ Fallow field	1,037/2,563	126	
Corn	970/2,397	118	
Soybean		253/626	31
Bottomland Hardwoods			
30% red oaks[2]	90/222	11	
50% red oaks	155/358	19	
70% red oaks[3]	229/566	28	
90% red oaks	302/747	37	

[1] Nelms and Twedt (1996)

[2] 30% red oaks is used a average composition in natural stand

[3] 70% red oaks is used in this appendix as average seedling survival rate in managed stand

Estimates were generated for the number of days of flooding until exhaustion of food resources at an average duck density. This density is assumed to be the point where declining foraging efficiency causes ducks to abandon a field. Reinecke et al. (1989) found this threshold foraging efficiency to be 50 kg/ha. The estimated Days To Exhaustion (DTE) of food resources is useful for determining the impact of the length of flooding on habitat values. DTE allows the inclusion of data on flood duration and is useful in determining the impacts of flood control projects on wintering waterfowl foraging habitat.

PROJECT IMPACTS

Future without project conditions for potential foraging habitat for wintering waterfowl are expected to remain the same as existing conditions. This assumes that existing institutional requirements that regulate development in wetlands are sufficient to ensure continuation of existing conditions.

Implementation of the proposed flood control project would greatly alter the availability of habitat for wintering and migrating waterfowl (Tables 3 and 4). One negative impact will be the loss of flooding diversity. Flood timing, duration and depth will be controlled through the pump operating plan, removing natural variability which contributes to the overall health and stability of wetlands ecosystems. Although both the Authorized Project and the Avoid and Minimize (A&M) alternatives would produce a net increase in total annual duck-use days (DUDs), those gains would appear in December and January, rather than February and March. In the St. Johns Bayou basin, the Authorized Project alternative would increase total DUDs by 464,906 while greatly reducing waterfowl use by 74,390 DUDs in February and March, during spring migration (Table 5). The A&M alternative for that basin is expected to increase total DUDs by 545,856 primarily because of increased moist soil and soybean acreage. That alternative, however, would also provide important bottomland habitat during spring migration. In the New Madrid Floodway, the Authorized Project alternative would increase the total seasonal DUDs by 50,140 while reducing February and March usage by 225,822 DUDs (Table 6); a pattern similar to that seen in St. Johns basin. The A&M alternative would also result in an increase of 53,374 total DUDs, while greatly decreasing late winter/early spring usage by 222,588 DUDs. Under both those alternatives, moist soil and BLH acreage flooded during spring migration would be significantly lower, reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988).

Increased DUDs indicated by WAM during December and January for both basins are the result of ponding in the sump as specified by the operational plan. Those potential gains, however, are very questionable. Traditional use of wintering waterfowl habitats in southeast Missouri is closely linked to the relative wetness (i.e., rainfall) within the regions during late October through January (Bellrose and Crompton 1970, Nichols et al. 1983). Forty-nine hundred acres of ponded water in an otherwise dry St. Johns basin and New Madrid Floodway is an extremely small tract of habitat to migrating waterfowl. For example, over the last several years, the Eagles Nest Wetland Reserve Program tract and rice fields on Hunter Farms have been annually flooded using pumps during fall and winter for hunting. Those habitats, however, receive significantly less waterfowl use in dry years than in years when the region is wet (D. Wissehr and B. Allen, MDC, per. comm.). In light of the above, we strongly recommend that the operational plan be altered to allow for the greatest possible diversity of flood timing, durations and depth during November through March. We believe such a plan will realize more benefits to waterfowl, as well as other species. Under the proposed alternatives, bottomland hardwoods in the sump area would be flooded annually to great depths for extended periods. Such inundation is detrimental to bottomland hardwood species (Fredrickson and Batema 1992) and could undermine their long-term survival. Altering the operational plan would also allow the river to ebb and flow into both basins during that time, greatly benefitting fisheries resources by maintaining connectivity between the river and its floodplain.

It is important to note that WAM does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, per. comm.). During that time, waterfowl are forming pairs, molting and preparing to breed (Heitmeyer 1985). Furthermore, the WAM does not consider other forested wetland habitat components necessary for healthy waterfowl populations. Forested wetlands fulfill special waterfowl habitat requirements not found in open land (i.e., moist soil units and cropland). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Both project alternatives would eliminate backwater flooding on thousands of acres of forested wetlands and moist soil areas during spring migration, significantly reducing habitat that provides necessary protein sources particularly important to waterfowl at that time of year. Under existing conditions, those waterfowl acres occur during spring flooding and are distributed over up to 75,000 acres. Such a large distribution is a critical factor for waterfowl, especially as they form breeding pairs. Because of the differing seasonal habitat requirements of waterfowl, potential fall migration and winter habitat benefits do not replace significant spring migration habitat losses that would occur with either project alternative.

CONCEPTUAL MITIGATION MEASURES

Completion of the St. Johns Bayou and New Madrid Floodway Project would result in wintering and migratory waterfowl losses in both basins. The following discussion, which is conceptual, is intended to provide examples of how intensively managing wintering waterfowl habitat can both increase foraging habitat for wintering waterfowl and meet their broader ecological requirements.

Reforestation is the Service's preferred mitigation technique for several reasons: 1) Reforestation constitutes an ecosystem approach to replacing the waterfowl values that would be lost through project construction. Not only would such a mitigation feature replace lost food values, but reforestation would also address all wintering waterfowl habitat requirements. In this appendix we have used food as an index of waterfowl habitat needs. Waterfowl are not able to divide their world and habitat needs into such neat compartments. A bottomland hardwood forest ecosystem provides food and other waterfowl habitat needs such as courtship sites, protection from predators and adverse weather, resting and roosting areas, and isolation from human disturbance. 2) Reforestation would provide a stable, low maintenance, high reliability mitigation feature. Mitigation features are designed to function for the entire 50-year project life. Other mitigation techniques that would replace lost waterfowl food values, such as moist soil management areas, would require periodic maintenance and/or active operation in order to provide the predicted food supply. With constantly changing funding priorities a "no maintenance-no operation-self sustaining" mitigation feature is much more reliable and cost effective. 3) The chance of successful waterfowl habitat value replacement is highest with reforestation. Reforestation would create a system that would mimic the previously existing bottomland hardwood ecosystem, which historically had a proven record of providing high quality waterfowl habitat (Reinecke et al. 1989). 4) Application of the principles of landscape ecology dictate that we use reforestation as the primary mitigation technique. The project area contains many large blocks of agricultural land and few large blocks of forested habitat. To restore ecosystem diversity, large blocks of forested habitat should be re-established. While meeting the goals of migratory waterfowl, bottomland hardwood forests would also meet the needs of neotropical migratory birds, many of which are declining (Hunter et al. 1993). Other management techniques would not benefit neotropical migratory birds. 5) Reforestation would also offset terrestrial and wetland habitat losses. 6) Reforestation would also benefit numerous other species such as game mammals and reptiles and amphibians. 7) Reforestation of marginal agricultural (farmed wetlands) or other cleared lands is technologically and economical feasible. Reforestation methods are varied and can be tailored to a specific site. Common techniques include direct seeding or planting seedlings and other activities ranging from extensive mowing and fertilization to only seed bed preparation.

Reforested compensation areas should be subject to frequent and sustained winter flooding 18 inches deep or less. Ideally, the flooding regime should mimic the historic flooding patterns in the area, including variability both within and among years. Forest stand composition should intentionally favor, although not exclusively, heavy seeded species dominated by red oaks for maximum benefits to wintering waterfowl. Table 7 shows the potential mitigation acres that could be required based on DUDs lost by each alternative. For example, the Service recommends reforestation with 70 percent red oak species that would provide 229 DUDs per acre annually. Benefits could be expected immediately due to the presence and availability of native moist soil plants in the newly planted "forest" and would gradually change to those benefits associated with forests dominated by red oaks and the associated invertebrate community.

Through the use of water control structures, moist soil, and soybean fields could be used to offset impacts to foraging habiatat resulting from project construction. Intensive management, however, would be required to achieve desired results with these three methods. In addition, numerous structures can greatly reduce fisheries value of a mitigation area due to reduced fish access.

Mitigation values achieved would vary depending on the land type established or improved. From Table 5, average annual duck-use-days/acre within the project area could be expected to range from 1,037 DUDs/acre for a moist soil area exclusively devoted to wintering waterfowl, to 253 DUDs/acre for a flooded harvested soybean field that has not been fall plowed or burned, to 229 DUDs/acre for reforested bottomland hardwoods with mast bearing species (assuming a 70 percent seedling survival rate). In addition to food values, establishment or enhancement of forested wetlands would provide other necessary habitat components to wintering and migrating waterfowl including isolation for pair bonding, better protection from disturbance and harassment than in more open areas, and protection from predation and extremes in weather conditions.

Unquantified benefits resulting from establishment of more dependable wintering waterfowl foraging habitat accrue to the whole range of resident and migratory species attracted to wetlands as well as overall wetland functional values. Not intended as all inclusive, the list of fauna benefitting would include resident aquatic furbearers, resident and migrant shore and water birds, insectivorous and granivorous neotropical migratory birds, native amphibians and reptiles, and the broad range of resident game and nongame birds and mammals known to spend time in forested wetlands and non-wooded wetlands such as moist soil areas. Depending on the location of the mitigation site, reforestation can also provide significant fisheries benefits to species that depend on bottomland hardwood forests as spawning and nursery areas.

Other functional wetland values would include flood storage, water quality attributes, ground water recharge, esthetics, and scientific study opportunities. Additionally, economic benefits would result from added outdoor recreation opportunities and the harvest of timber and other wood products. Economic losses could result in those instances where existing agricultural practices/leases might have to be modified.

CONCLUSION

Implementation of the proposed flood control project would greatly alter the availability of habitat for wintering and migrating waterfowl. Although both the Authorized Project and the A&M alternatives could potentially produce a net increase in total annual duck-use days (DUDs), those gains would appear in December and January, rather than February and March. Waterfowl benefits during December and January, however, will be localized and limited to the sump areas of both the St. Johns Bayou basin and the Floodway. Under existing conditions, those waterfowl acres occur during spring flooding cover up to over 75,000 acres in the Floodway alone. Such a large distribution is a critical factor for waterfowl. Upon receding, those floodwaters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A variety of waterfowl, not to mention other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Significant alterations in the extent and timing of seasonal flooding in the project area concern the Service not only because of the potential adverse impacts upon migratory waterfowl, a federal trust resource, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

LITERATURE CITED

Bellrose, F.C. 1980. Ducks, Geese, and Swans of North America. Stackpole Books, Harrisburg, PA. 540 pp.

Bellrose, F.C. and R.D. Crompton. 1970. Migrational behavior of mallards and black ducks as determined from banding. *Illinois Natural History Survey Bulletin* 30:167-234.

Combs, D.L. 1987. Ecology of male mallards during winter in the upper Mississippi Alluvial Valley. Ph.D. Thesis, Univ. Missouri, Columbia. 223pp.

Delnicki, D. and K.J. Reinecke. 1986. Mid-winter food use and body weights of mallards and wood ducks in Mississippi. *J. Wildl. Manage*. 50:43-51.

Fredrickson, L.H. and D.L. Batema. 1992. Greentree reservoir management handbook. Univ. Missouri, Columbia. 88pp.

Fredrickson and Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323. *In*, M.W. Weller (ed.), Waterfowl in Winter - a symposium. Univ. Minnesota Press, Minneapolis, MN.

Heitmeyer, M.E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the upper Mississippi Delta. Ph.D. Thesis, Univ. Missouri, Columbia. 376 pp.

Hunter, W.C., D.N. Pashley and R.E.F. Escano. 1993. Neotropical migratory landbird species and their habitats of special concern within the southeast region. Pages 159-171, *In* D.M. Finch and P.W. Stangel (eds.), Status and Management of Neotropical Migratory Birds. U.S.D.A. For. Serv. Gen. Tech. Rep. RM-229. 422 pp.

Loesch, C.R., K.J. Reinecke and C. K. Baxter. 1994. Lower Mississippi Valley Joint Venture Evaluation Plan. North American Waterfowl Management Plan, Vicksburg, MS. 34 pp.

McAbee, W.C. 1994. Waterfowl use and food availability on flooded croplands in northeast Louisiana. M.S. Thesis, La. Tech Univ., Ruston, La. 49pp.

McKenzie, D.F. 1987. Utilization of rootstocks and browse by waterfowl on moist soil impoundments in Missouri. M.S. Thesis, Univ. Missouri, Columbia. 93pp.

MDC. 1989. Missouri Department of Conservation Wetlands Management Plan. 157pp.

Nelms, C.O and D.J. Twedt. In Prep. A refined method of quantifying winter dabbling duck habitat changes in the Mississippi Alluvial Valley. *In*: Proceedings of the DELTA Conference. Memphis, TN.

Nelms, C.O. and D.J. Twedt. 1996. Seed deterioration in flooded agricultural fields during winter. *Wildl. Soc. Bull.* 24(1):85-88.

Nichols, J.D., K.J. Reinecke and J.E. Hines. 1983. Factors affecting the distribution of mallards wintering in the Mississippi Alluvial Valley. *Auk* 100:932-946.

Paulus, S.L. 1980. The winter ecology of gadwall in Louisiana. M.S. Thesis, Univ. Of North Dakota, Grand Forks, N.D. 357 pp.

Reinecke, K.J. 1989. Preliminary guidelines for evaluating foraging habitat. Monitoring and evaluation committee reports. Lower Mississippi Valley Joint Venture, Vicksburg, MS.

Reinecke, K.J., C.W. Shaiffer, and D. Delnicki. 1987. Winter survival of female mallards wintering in the lower Mississippi valley. *Trans. North Am. Wildl. and Nat. Resour. Conf.* 52:258-263.

Reinecke, K.J., J.D. Moorhead, J.D. Hodges, and J.R. Nasser. 1989. Mississippi Alluvial Valley. Pages 203-247 in L.M. Smith, R.L. Pederson, and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech Univ. Press, Lubbock. 560 pp.

U.S. Army Corps of Engineers. 1991. Upper Steele Bayou project reformulation study. Vicksburg, MS. 566 pp.

U.S. Army Corps of Engineers. 1993. Upper Yazoo projects reformulation study. Vicksburg, MS. 438 pp.

U.S. Army Corps of Engineers. 1997. St. Johns Bayou and New Madrid Floodway Missouri, First Phase, Draft Limited Reevaluation Report.

U.S. Army Corps of Engineers. 1998. Draft Supplement No. 1 to the Final Envrionmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Levee and Channel Improvement.

U.S. Fish and Wildlife Service and Canadian Wildlife Service. 1986. North American waterfowl management plan. Washington D.C. 31 pp. w/append.

U.S. Department of the Interior. 1988. The impact Federal programs on Wetlands. Volume I. 114 pp.

Wills, D. 1970. Chufa tuber production and its relationship to waterfowl management on Catahoula Lake, Louisiana. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 24:146-153.

Wright, T.W. 1961. Winter foods of mallards in Arkansas. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 13:291-296.

ST. JOHNS BAYOU

AND

NEW MADRID FLOODWAY, MISSOURI

East Prairie Phase

Appendix C

Forested Wetlands

Habitat Evaluation Procedures

Analysis and Results

The Fish and Wildlife Service developed the Habitat Evaluation Procedures (HEP) to document the quality and quantity of available habitat for fish and wildlife species within a given area. Using HEP, habitat quality and quantity can be measured for baseline conditions, and can be predicted for future without-project and future with-project habitat conditions. This standardized, species-based method numerically compares future without-project and future with-project conditions to estimate project impacts on fish and wildlife resources. We used the 1980 version of HEP (USFWS 1980) to evaluate the impacts of the St. Johns Bayou and New Madrid Floodway Project, East Prairie Phase on wildlife habitat value of forested wetlands and marsh.

The Authorized Project alternative includes vegetative clearing along 4.3 miles of rural channels and enlarging 23.4 miles of rural channels in the St. Johns basin. The project also includes a 1,000 cubic-foot-per second (cfs) pump station in St Johns basin, and a 1,500 cfs pump station in the New Madrid Floodway. Additional work, authorized by the Flood Control Act of 1954, includes closing and installing a gravity drainage structure in the existing 1,500-foot opening at the southern end of the New Madrid Floodway. The project is expected to provide a 2-year level of flood protection in the area of East Prairie, and a 1.1-year level of flood protection to primarily agricultural land in the floodway. The Army Corps of Engineers (Corps) is also evaluating an Avoid and Minimize alternative (A&M) alternative which would reduce channel widening in St. Johns Bayou, allow higher (than authorized) water levels in both basins, and restrict bank work to one side of the channel to minimize impacts to riparian corridors.

For this project, Gulf Engineers and Consultants, Inc. (GEC) and Corps biologists collected field measurements from those forested wetlands and marsh throughout the project area to determine baseline habitat conditions. (Details regarding field data are on file in the Service's Columbia, Missouri Field Office.) Using HEP species models, those measurements were mathematically combined to obtain a value between 0.0 and 1.0. That value is termed the habitat suitability index (HSI); 0.0 represents no habitat value for an evaluation species and 1.0 represents optimum habitat value. The HSI is a linear index, with the degree of difference between 0.0 and 0.1 being the same as the degree of difference between 0.9 and 1.0.

Habitat units are the product of the evaluation species' HSI and the acreage of available habitat at a given target year. The habitat unit (HU) is the basic unit of HEP to measure project effects on fish and wildlife. Changes in habitat units reflect changes in the habitat quality (HSI) and quantity (i.e., acres); those changes are predicted for selected target years over the period of analysis under future without-project and future with-project conditions. Those values are then annualized over the economic project life to determine the average annual habitat units (AAHUs) available for each species. The difference in AAHUs under future with-project conditions versus future without-project conditions provides a quantitative measure of expected projects impacts. An increase in average annual habitat units indicates that the project will benefit the evaluation species. A decrease in average annual habitat units indicates that the project will negatively affect the evaluation species.

An interagency team composed of biologists from the Corps, the Service, the Missouri Department of Conservation (MDC), and GEC selected the evaluation species similar to those used in the Supplemental Environmental Impact Statement for Mississippi River Mainline Levees Enlargement and Seepage Control Project (U.S. Army Corps of Engineers 1998) because the levee closure is a feature of the Mississippi River and Tributaries Project. The barred owl (Allen 1987), the pileated woodpecker (Schroeder 1983), the Carolina chickadee (Schroeder unpubl.), and the fox squirrel (Allen 1982) models were used to assess forested wetland (BLH) habitat. Those models measure canopy cover, mast-producing tree species, tree width and height, and snags to quantify the age and stand quality (particularly to cavity nesters) of forested wetland tracts in the project area. It is important to note that those models rely largely on plant community parameters and therefore are not very sensitive to hydrologic changes of the magnitude expected from implementation of either project alternative. The mink model (Allen 1986) was used to measure riparian cover (vegetation and organic debris), as well as forested canopy cover. To evaluate marsh and scrub/shrub habitats, the team used the red-winged blackbird (Short 1985), the great blue heron (Short and Cooper 1985), and the muskrat (Allen and Hoffman 1984) models. Those models measure vegetation composition and structure, as well as the water regime to assess the quality of marsh and scrub/shrub habitat for those species.

The St. Johns and New Madrid Floodway Project, East Prairie Phase, has a 50-year project life. According to the Corps, project construction will take five years. Therefore, the HEP period of analysis includes the initial five-year construction period and the 50-year project life. Several target years (TY) were added to better measure habitat changes over the period of analysis. In addition to TYs 0, 1, and 55 (required by the HEP models) the team added TYs 5 (project completion), 25, 30, 45, and 50 to show BLH forest regeneration along the project rights-of-way. Acreage for areas affected by the project were calculated for each alternative by the Memphis District Corps. To determine changes in inundation, acres for each cover type considered within the project area were queried from a Geographic Information System (GIS) elevation model and presented for one-foot increments for the entire study area.

The interagency team oversaw all HEP analyses and developed assumptions for existing, future with-project, and future without-project conditions to quantify habitat changes. Under the future without-project alternative, the team assumed that habitat quality and quality would remain essentially unchanged from existing conditions. Under the future with-project alternatives, the team initially agreed that 90 percent of existing privately owned forested wetlands that will be dewatered during the growing season due to the levee closure and pump operations would be converted to agriculture over the 50-year life of the project (excluding timber company land, lands in the WRP program and mitigation land). Since then, the Corps has reviewed soil surveys and Mississippi River seepage information and concluded there would be no induced development of forested wetlands because of the project. They maintain that forested wetlands will remain wet and therefore protected under existing wetlands regulations. Neither the Service nor MDC has seen any information to change their initial assumptions. Therefore, the HEP analyses quantified direct and indirect habitat impacts separately. Based on information from the Corps, the team assumed that habitat in the project footprint (i.e., construction and staging areas) would be cleared completely in the first year of construction, while habitat along channel rights-of-way will be cleared at a rate of 20 percent per year over the five years of construction. Other assumptions concerning future land use were adopted from project design specifications which include conservation easements over the channel rights-of-way to allow natural revegetation. Using the GIS-generated area figures and the guidance and assumptions of the HEP team, acreage figures for each project area under each alternative were calculated. The mink analysis was run separately since suitable habitat for the mink (adjacent to permanent water) was not found uniformly in the stands sampled for BLH.

HEP results for different alternatives are readily comparable in the form of AAHUs reflecting the average gain or loss of habitat per year over the life of the project. Table C-1 shows the habitat changes associated with the channel work and construction of the levee closure and both pump stations.

Table C- 1. Direct forested wetland habitat losses from levee construction and channel enlargement (expressed in average annual habitat units).

Species	St. Johns basin Author.	St. Johns basin A&M	New Madrid Floodway Author./A&M
Barred owl	677.81	488.82	15.22
Fox squirrel	386.57	281.54	11.49
Pileated woodpecker	547.44	393.23	12.56
Carolina chickadee	714.33	514.83	15.43
Mink	428.21	314.13	11.28
Total	2,754.37	1,992.55	65.98

Channel enlargement will include clearing portions the riparian corridor within the channel work rights-of-way and, in some reaches, removing the banks to enlarge the channel. Construction of the levee closure and pump station in the New Madrid Floodway will also involve clearing the rights-of-way immediately surrounding the closure structure, directly affecting only a small acreage of forested wetlands in the Floodway. Clearing along those rights-of-way will lead to a complete loss of forested wetland habitat value for the years immediately following project construction. Although those areas will be placed under a conservation easement, it will take between 25 and 35 years of natural regeneration for those areas to provide even moderate habitat value for the selection species (Table C-2). Because of its need for habitat structure found in mature forested wetlands, the pileated woodpecker will see no habitat value replacement in those regenerated forest tracts over the next 50 years (i.e., project life).

The indirect effects of the proposed alternatives will be far greater, particularly in the Floodway. As previously mentioned, the Service and MDC believe that implementation of either project alternative will lead to conversion of significant tracts of forested wetlands no longer subject to backwater flooding. Unlike the losses associated with project construction, we assumed the indirect wetlands losses (i.e., converted to agriculture) would occur at a constant rate (1.8 percent annually) over the 50-year project life.

Table C-2. Changes in habitat suitability of naturally regenerated riparian forests along the construction rights-of-way.

	Target Years							
Species	0	1	5	25	30	45	50	55
Barred owl	.87	.87	.00	.00	.00	.39	.39	.39
Fox squirrel	.69	.69	.00	.33	.33	.33	.33	.33
Pileated woodpecker	.60	.60	.00	.00	.00	.00	.00	.00
Carolina chickadee	1.00	1.00	.00	.00	.00	.34	.34	.34
Mink	.89	.89	.00	.55	.55	.61	.61	.61

Table C-3 summarizes the indirect habitat losses associated with conversions of forested wetlands to cropland. All wildlife evaluation species showed significant losses in habitat values due to induced wetlands impacts. Habitat losses in the Floodway are orders of magnitude higher than direct habitat losses, and twice as high as indirect impacts in the St. Johns Bayou basin. Floodway habitat losses are primarily due to low water levels under either project alternative. In addition to impacts that can be quantified through HEP analyses, wildlife using the remaining forested tracts will also be negatively affected by increasing forest fragmentation which is particularly detrimental to certain neotropical migratory bird species. Fragmentation can lead to higher rates of nest parasitism and competition from birds species that prefer edge habitat.

Table C-3. Potential forested wetland habitat losses from reduced backwater flooding. (expressed in average annual habitat units).

	St. Johns basin	New Madrid Floodway	
Species	Author/A&M.	Author.	A&M
Barred owl	645.85	1,714.75	1,642.37
Fox squirrel	613.35	1,349.50	1,292.53
Pileated woodpecker	512.68	1,498.32	1,436.41
Carolina chickadee	661.04	1,717.50	1,645.00
Mink	390.01	216.45	200.85
Total	2,822.93	6,496.52	6,217.16

Three species (i.e., muskrat, red-winged blackbird, and great blue heron) were used to evaluate project-related changes in marsh habitat values. Most of the marsh in the study area is found in the New Madrid Floodway, primarily along borrow pits. The HEP team assumed those acres would remain the same because those areas should receive enough rainfall and runoff to maintain marsh vegetation. Based on that assumption, the only species that showed changes in habitat values was the muskrat (increased 4 AAHUs). Therefore, HEP results indicate that project-related changes in marsh habitat values will be insignificant.

Compensation Measures

Habitat value of forested wetlands in the project area will decline significantly because of channel enlargement, levee closure, and pumping operations. To compensate for that habitat loss, we recommend that the Corps purchase croplands in fee-title to be reforested. Reforestation can be a very effective and efficient compensation measure. Depending on the location and flooding regime, restoration of forested wetlands could meet the needs of forest wildlife, waterfowl, and fisheries. Ideally, those lands should be located in an area not currently flooded, but with the potential to restore the hydrology to a functioning forested wetland. Locating compensation area(s) on cropped wetlands would still result in a net loss of wetlands due to the project. Ideally, compensation site(s) should be located in the basin (i.e., St. Johns basin or the Floodway) commensurate with project impacts in that area. According to Corps guidelines, however, final site selection will be determined, to a great extent, by the availability of willing sellers. Specific details on species mix and methods will depend on the location of the compensation site(s) (e.g., soil, flooding regime, size, etc.) and will be developed by the Service and MDC. In general, however, compensation acres should be directly seeded, weeds controlled for a minimum of five years, and 70 percent tree survival attained at the end of five years. If necessary, at the end of five years, the area should be replanted and weed control implemented until the 70 percent survival threshold is met.

The project will directly decrease forested wetland habitat value in the project area by 2,820 and 2,058 AAHUs under the Authorized Project and A&M alternatives, respectively. To compensate that habitat loss, approximately 2,118 acres (Authorized Project alternative) or 1,546 acres (A&M alternative) of croplands should be reforested as described above. The habitat values for each species may change depending on the characteristics of the mitigation site(s). For example, the mink HSI for an acre of reforested BLH land in Table C-4 is based on a tract that has surface water present only 4 months of the year (longer may affect the health of the trees). Located a mitigation tract along a dtich, bayou or oxbow, however, could substantailly increase the habitat suitability of that site for mink. It should be noted that full replacement of forested wetland functions will not occur for many years given the time needed to grow large, mature trees. We estimate that it will take at least 50 years for a mitigation site to approach the habitat quality that currently exists in the project area. In addition, using the direct seeding method, the mitigation site will still not compensate for lost habitat value to the pileated woodpecker (an evaluation species) because of the woodpecker's need for mature forested wetlands. There is an

Table C-4. Compensation for habitat losses from direct project impacts

AAHUs per 100 acres of compensation area

Species	Acorns	Seedlings	RPM
F. squirrel	53.76	43.88	64.04
P. woodpecker	0	0	21.89
C. chickadee	56.81	54.65	61.72
B. owl	22.6	18.2	49.61
Mink	0	0	0
Total	133.17	116.73	197.26

Direct habitat losses for forested wetlands (in average annual habitat units)

St. Johns Bayou Basin

Species	Authro. Prj.	A&M
F. squirrel	386.58	281.54
P. Woodpecker	547.44	393.23
C. chickadee	714.33	514.83
B owl	677.81	488.82
Mink	428.21	314.13
Total	2754.37	1992.55

New Madrid Floodway

Species	Author. Prj. and A&M
F. squirrel	11.49
P. Woodpecker	12.56
C. chickadee	15.43
B owl	15.22
Mink	11.28
Total	65.98

Compensation acres to replace habitat losses from direct impacts

	Acorns	Seedlings	RPM
Authorized Project	2068.31	2359.61	1396.31
A&M altern.	1496.25	1706.97	1010.11

	Acorns	Seedlings	RPM
Authorized Project and A&M altern.	49.55	56.52	33.45

experimental method, however, that may provide some of that habitat value within the project life. The root production method (RPM) has been shown to give young trees a several years "head start" (i.e., mast production within 7-10 years)(B. Allen and D. Wissehr, MDC, per. comm.). Because of this potential and its experimental nature, we recommend that the Corps plant a portion (≤ 15 percent) of the compensation area with trees subject to RPM to possibly compensate for mature BLH habitat losses. In rare instances, preservation of an existing high quality tract of forested wetlands, may be an acceptable compensation measure. Such cases, however, occur when there is no suitable acreage to reforest. Preservation is another instance where compensating wetland habitat losses with existing wetlands results in a net loss of wetlands in a project area.

The Service and MDC believe there will be significant indirect, project-related effects to forested wetlands because of hydrologic changes (i.e., eliminating seasonal inundation). As previously mentioned, we believe conversion of forested wetlands to other land uses (primarily agriculture) would result in a loss of approximately 2,823 AAHUs in the St. Johns basin, and 6,496 AAHUs for the Authorized Project or 6,217 AAHUs for the A&M alternatives in the New Madrid Floodway. We recommend that the Corps purchase in fee-title, sufficient croplands to fully compensate habitat losses from induced development of those wetlands. Using the same reforestation methods described above, approximately 2,120 acres would be necessary to compensate for project-related habitat losses in the St. Johns Bayou basin. In the New Madrid Floodway, 4,787 acres (Authorized Project) or 4,669 acres (A&M) would be required to compensate for forested wetland habitat losses from the levee closure and pump operations under the Authorized Project and A&M alternatives, respectively (Table C-5).

Literature Cited

Allen, A.W. 1982. Habitat suitability index models: Fox squirrel. U.S. Fish and Wildlife Service, Biological Report 82 (10.18). 11 pp.

Allen, A.W. 1986. Habitat suitability index models: Mink (revised). U.S. Fish and Wildlife Service, Biological Report 82 (10.127). 28 pp.

Allen, A.W. 1987. Habitat suitability index models: Barred owl. U.S. Fish and Wildlife Service, Biological Report 82 (10.143). 17 pp.

Allen, A.W. and R.D. Hoffman. 1984. Habitat suitability index models: Muskrat. U.S. Fish and Wildlife Service, Biological Report 82 (10.46). 27 pp.

Schroeder, R.L. 1983. Habitat suitability index models: Pileated woodpecker. U.S. Fish and Wildlife Service Biological Report 82 (10.39). 15 pp.

Schroeder, R.L. Unpubl. Habitat suitability index models: Carolina Chickadee. U.S. Fish and Wildlife Service.

Short, H.L. and R.J. Cooper. 1985. Habitat suitability index modes: Great blue heron. U.S. Fish and Wildlife Service Biological Report 82 (10.99). 23 pp.

Short, H.L. 1985. Habitat suitability index modes: Red-winged blackbird. U.S. Fish and Wildlife Service Biological Report 82 (10.95). 20 pp.

U.S. Army Corps of Engineers. 1998. Mississippi River Mainline Levees Enlargement and Seepage Control, Cape Girardeau, Missouri to Head of Passes, Louisiana, Project report and Supplemental Environmental Impact Statement. Vicksburg, Memphis and New Orleans Districts, Army Corps of Engineers. 58 pp. and appendices.

U.S. Fish and Wildlife Service. 1980. Habitat suitability procedures. U.S. Fish and Wildlife Services, Division of Ecological Services, Washington D.C. Ecological Services Manual 102.

Table C-5. Compensation for habitat losses from indirect project impacts

AAHUs per 100 acres of compensation area

Species	Acorns	Seedlings	RPM
F. squirrel	53.76	43.88	64.04
P. woodpecker	0	0	21.89
C. chickadee	56.81	54.65	61.72
B. owl	22.6	18.2	49.61
Mink	0	0	0
Total	133.17	116.73	197.26

Habitat losses for forested wetlands (in average annual habitat units)

St. Johns Bayou Basin

Species	Author. Prj. And A&M
F. squirrel	613.35
P. woodpecker	512.68
C. chickadee	661.04
B owl	645.85
Mink	390.01
Total	2,822.93

New Madrid Floodway

Species	Author. Prj.	A&M
F. squirrel	1,349.50	1,292.53
P. woodpecker	1,498.32	1,436.41
C. chickadee	1,717.50	1,645.00
B owl	1,714.75	1,642.37
Mink	216.45	200.85
Total	6,496.52	6,217.16

Compensation acres to replace habitat losses from indirect impacts

	Acorns	Seedlings	RPM
Authorized Project and A&M altern.	2119.79	2418.34	1431.07

	Acorns	Seedlings	RPM
Authorized Project	4878.37	5565.42	3293.38
A&M altern.	4668.59	5326.10	3151.76

ST. JOHNS BAYOU

AND

NEW MADRID FLOODWAY, MISSOURI

East Prairie Phase

Appendix D

Shorebird

Habitat Evaluation Procedures

Analysis and Results

The Fish and Wildlife Service developed the Habitat Evaluation Procedures (HEP) to document the quality and quantity of available habitat for fish and wildlife species within a given area. Using HEP, habitat quality and quantity can be measured for baseline conditions, and can be predicted for future without-project and future with-project habitat conditions. This standardized, species-based method numerically compares future without-project and future with-project conditions to estimate project impacts on fish and wildlife resources. An interagency work group of biologists from the Service, the Missouri Department of Conservation, the Army Corps of Engineers (Corps), and the U.S. Geological Survey (Biological Resources Division) met to develop a model that would evaluate the impacts of the St. Johns Bayou and New Madrid Floodway Project, East Prairie Phase, on spring shorebird migration habitat in the project area (see attached).

The Authorized Project alternative includes vegetative clearing along 4.3 miles of rural channels and enlarging 23.4 miles of rural channels in the St. Johns basin. The project also includes a 1,000 cubic-foot-per second (cfs) pump station in St Johns basin, and a 1,500 cfs pump station in the New Madrid Floodway. Additional work, authorized by the Flood Control Act of 1954, includes closing and installing a gravity drainage structure in the existing 1,500-foot opening at the southern end of the New Madrid Floodway. The Corps is also evaluating and Avoid and Minimize alternative (A&M) alternative which would reduce channel widening in St. Johns Bayou, allow higher (than authorized) water levels in both basins, and restrict bank work to one side of the channel to minimize impacts to riparian corridors.

Habitats considered for shorebird use included non-forested wetlands, herbaceous areas, rice, and other cropland including soybeans, corn, cotton and wheat. Since no general models for shorebirds were deemed applicable to the flooding regime in the project area, a shorebird model was developed to analyze the potential and existing habitat in the project area. The work group used the 1980 version of HEP (USFWS 1980) as the foundation for a model that specifically analyzed changes in shorebird foraging habitat value. HEP models use species-specific parameters to measure habitat value for that species for a given area. Those measurements are mathematically combined to obtain a value between 0.0 and 1.0. That value is termed the habitat suitability index (HSI); 0.0 represents no habitat value for an evaluation species and 1.0 represents optimum habitat value. The HSI is a linear index, with the degree of difference between 0.0 and 0.1 being the same as the degree of difference between 0.9 and 1.0.

Habitat units are the product of the evaluation species' HSI and the acreage of available habitat at a given target year. The habitat unit (HU) is the basic unit of HEP to measure project effects on fish and wildlife. Changes in habitat units reflect changes in the habitat quality (HSI) and quantity (i.e., acres); those changes are predicted for selected target years over the period of analysis under future without-project and future with-project conditions. Those values are then annualized over the economic project life to determine the average annual habitat units (AAHUs) available for each species. The difference in AAHUs under future with-project conditions versus future without-project conditions provides a quantitative measure of expected projects impacts. An increase in average annual habitat units indicates that the project will benefit the evaluation species. A decrease in average annual habitat units indicates that the project will negatively affect the evaluation species.

The Corps used a Geographic Information System (GIS) to evaluate satellite imagery land use data. That information, combined with a hydrologic model, was used to determine the acreage of suitable spring shorebird migration habitat available within the designated elevation zones by cover type. Cropland and other herbaceous cover types that were flooded no more than 18 inches were considered suitable habitat. Those cover types were then divided into two elevation zones: ±1 foot of the 50 percent flood exceedence level (Elevation Zone 1); > 1 foot above the 50 percent flood exceedence level (Elevation Zone 2). Suitable cover types included: rice, crops, and herbaceous vegetation in Zone 1; and rice, crops, and non-forested wetlands in Zone 2.

An interagency HEP team (i.e, the Service, MDC, Corps and the GEC, Inc.) developed assumptions for each alternative and oversaw model analyses and results. Under future without project conditions, suitable shorebird migration habitat was expected to remain unchanged. Under future with-project conditions, the Team estimated that cropping patterns within the project area would be distributed as follows: 20% Rice; 25% Corn; 55% Soybean (Tables D-2 and D-3). The total acreage for each cover type within each elevation zone was multiplied by the HSI of that cover type for March, April, and May to determine HUs for those months. The HUs for March, April, and May were then combined to yield the total HUs within each basin for each project alternative (Table D-1).

Table D-1. Summary of AAHUs for shorebird habitat under the action alternatives of the St. Johns Bayou and New Madrid Floodway project.

Basin/habitat	AUTHORIZED PROJECT	AVOID/MINIMIZE
New Madrid	-672.28	-656.78
Saint John's	-119.17	-104.42
Total	- 791.45	-761.20

Changes in shorebird habitat reflect both changes in acres of suitable habitat for feeding, and shifts in cropping patterns associated with reduced spring flooding. While both basins show a significant reduction in shorebird habitat, the loss of habitat in the New Madrid Floodway is approximately six times that of the St John's Bayou basin. Project implementation would decrease spring shorebird habitat St. Johns Bayou basin by approximately 30 percent, while suitable habitat in the Floodway would decrease almost 70 percent. Although rice acreage (which has high shorebird habitat value) would increase in the Floodway, those gains will not offset the dramatic decrease in flooded acres throughout the basin.

Table D-1. Acres by elevation zone and cover type used for the shorebird spring migration HEP analysis of the St. Johns Bayou basin.

	Elevation Zone #1 ±1 foot of 50% Exceedence Level			Elevation Zone #2 > 1 foot above 50% Exceedence Level		
Target Year	Rice	Crop	Herbaceous	Rice	Crop	Non-Forested Wetland
WITHOUT PROJECT CONDITIONS						
0	0	1720.82	227.52	0	8240.80	1061.60
5	0	1720.82	227.52	0	8240.80	1061.60
25	0	1720.82	227.52	0	8240.80	1061.60
55	0	1720.82	227.52	0	8240.80	1061.60
AUTHORIZED PROJECT ALTERNATIVE						
0	0	1720.82	227.52	0	8240.80	1061.60
5	0	38.36	3.82	0	7641.72	1038.81
25	0	38.36	3.82	72.96	7641.72	1038.81
55	0	38.36	3.82	72.96	7641.72	1038.81
AVOID AND MINIMIZE ALTERNATIVE						
0	0	1720.82	227.52	0	8240.80	1061.60
5	0	440.54	86.64	0	7081.76	921.57
25	0	440.54	86.64	72.96	7081.76	921.57
55	0	440.54	86.64	72.96	7081.76	921.57

Table D-2. Acres by elevation zone and cover type used for the shorebird spring migration HEP analysis of the New Madrid Floodway with levee closure.

	Elevation Zone #1 ±1 foot of 50% Exceedence Level			Elevation Zone #2 > 1 foot above 50% Exceedence Level		
Target Year	Rice	Crop	Herbaceous	Rice	Crop	Non-Forested Wetland
EXISTING CONDITIONS						
0	0	1632.60	109.90	0	36968.30	2803.40
5	0	1632.60	109.90	0	36968.30	2803.40
25	0	1632.60	109.90	0	36968.30	2803.40
55	0	1632.60	109.90	0	36968.30	2803.40
AUTHORIZED PROJECT ALTERNATIVE						
0	0	1632.60	109.90	0	36968.30	2803.40
5	0	23.10	18.40	0	0	0
25	0	22.20	18.40	885.56	0	0
55	0	22.20	18.40	885.56	0	0
AVOID AND MINIMIZE ALTERNATIVE						
0	0	1632.60	109.90	0	36968.30	2803.40
5	0	210.20	46.20	0	98.60	20.20
25	0	210.20	46.20	877.20	98.60	20.20
55	0	210.20	46.20	877.20	98.60	20.20

Compensation Measures

There are a number of ways to provide suitable shorebird habitat to compensate for project-related losses during spring migration. The first in-kind scenario would be to flood crop land during the months of April and May to depths no more than 18 inches. Another alternative would be to similarly flood herbaceous cover (i.e., moist soil areas) during spring migration.

The shorebird model predicts that herbaceous wetlands with one foot of water will yield twice the shorebird habitat value than flooded cropland. Using HEP software to analyze both measures shows flooded cropland to provide .5 AAHUs and herbaceous wetlands to provide .995 AAHUs per acre of mitigation land. Therefore, to compensate for project-related habitat losses, we recommend the Corps secure, either through fee-title or easements, appropriate acreage to be managed for shorebirds habitat during March, April, and May (D-4). As previously noted, herbaceous wetlands provide more habitat value per acre than flooded cropland, so fewer compensation acres of that habitat type would be needed. In addition, depending on the depths of and access to an area, shallow flooded cropland or herbaceous wetland acreage could be used to offset a small portion of the habitat losses to fisheries and waterfowl. Ideally, mitigation sites would be located in areas that could be restored hydrologically and be essentially self-maintaining. Alternatively, structures within the existing drainage network in the project area could possibly be used to

Table D-4. Acres needed to compensate spring (April and May) shorebird habitat losses.

St. Johns Bayou basin	Authorized Project	A&M
flooded cropland	238	209
herbaceous wetlands	120	105
New Madrid Floodway		
flooded cropland	1345	1314
herbaceous wetlands	676	660

seasonally trap rainwater on agricultural lands to provide spring shorebird habitat. Another option would be to create habitat by installing small dikes and pumping systems to control water levels regardless of precipitation or backwater flooding (i.e., moist soil areas). Both those measures, however, would largely reduce or eliminate fisheries access to that site. Furthermore, although shallow water along the edges of borrow ditches may be suitable for shorebirds, existing borrow pits in the project area do not receive much shorebird use (B. Allen and D. Wissehr, MDC, pers. comm.). That may be related to the size of the borrow pits, or the presence of tall riparian vegetation and proximity to the Setback Levee both of which could obstruct the birds long-range vision.

LITERATURE CITED

U.S. Fish and Wildlife Service. 1980. Habitat suitability procedures. U.S. Fish and Wildlife Services, Division of Ecological Services, Washington D.C. Ecological Services Manual 102.

FISHERIES HABITAT EVALUATION PROCEDURES

St. Johns and New Madrid Floodway, Missouri

East Prairie Phase

Appendix E

IMPACTS OF ST. JOHNS BAYOU-NEW MADRID FLOODWAY FLOOD CONTROL PROJECT ON FISHES

K. Jack Killgore and Jan Jeffrey Hoover

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
Vicksburg, Mississippi 39180-6199

November 30, 1998

Prepared for
U.S. Army Engineer District, Memphis
Memphis, Tennessee 38103-1894

PREFACE

Losses in fish habitat resulting from the St. Johns-New Madrid project are described. This report is an appendix to an Supplemental Environmental Impact Statement being prepared by the US Army Engineer District, Memphis (CEMVM).

An interagency team of biologists helped develop the approach and provided habitat ratings for evaluation species: Mark Boone and Gary Christoff of the Missouri Department of Conservation (MDC), Gary Frazier and Jane Ledwin of the U.S. Fish and Wildlife Service (USFWS), and John Rumancik of the Memphis District Corps of Engineers (MVM). Chris Mills and Andy Gaines, MVM, provided floodplain acres and other project specifications. Steven George and Bradley Lewis of the U.S. Army Engineer Waterways Experiment Station (CEWES) and Dyntel assisted with cover surveys.

During the conduct of this study Dr. John Harrison, was Director, Environmental Laboratory, Dr. Conrad J. Kirby was Chief, Ecological Research Division, and Dr. Edwin A. Theriot were Chief, Aquatic Ecology Branch at CEWES.

Commander and Director of CEWES during publication of this report was COL Robin R. Cababa, EN, and the Technical Director was Dr. Robert W. Whalin.

CONTENTS

LIST OF TABLES

ABSTRACT

A flood control project is being evaluated for the St. Johns Bayou and New Madrid Floodway basins, located in southeast Missouri. Measures include channel excavation in the St. Johns Basin, closing the gap in the levee at the outlet of the New Madrid Floodway, and construction of two pumping stations to help drain interior water. The Habitat Evaluation Procedure (HEP) was used to determine losses in reproductive Habitat Units (HU's) for twelve species of fish that together represent 91% of fish species occurring in the project area.

Channel excavation in the St. Johns Basin will remove a total of 60.57 acres of riverbank structure under the Authorized alternative resulting in a net loss of 145 HU's . The Avoid and Minimize alternative will create a narrower channel, alternate banks, and avoid important structural resources, removing a total of 36.17 acres of riverbank structure resulting in a net loss of 58 HU's. Nine dikes will be placed along alternating banks in the lower 4 miles of St. Johns resulting in a habitat gain of 3.6 HU's. Overall, the Avoid and Minimize alternative results in a 60% savings in riverbank HU's over the authorized alternative.

An average of 3070 and 4231 acres of rearing habitat is inundated at least once every two years during the reproductive season (Mar-Jun) in the St. Johns and New Madrid Basins, respectively. Of these acres, approximately 52% are inundated greater than or equal to 8 days with depth of flooding greater than or equal to 1 ft (i.e., spawning acres). Reduction of rearing acres in the St. Johns Basin will result in an average loss of 47% and 43% HU's for the Authorized and Avoid and Minimize alternatives, respectively. Average spawning HU's will be reduced by 54% and 49%, respectively. Floodplain impacts in the New Madrid Floodway Basin are substantially higher. Average rearing acres will be reduced to 116 acres for the Authorized alternative and 307 acres for the Avoid and Minimize alternative, resulting in a 97% and 91% loss of HU's, respectively. Average spawning acres will be reduced to 49 acres for the Authorized alternative and 121 acres for the Avoid and Minimize alternative, resulting in a 97% and 91% loss of HU's, respectively. Thus, magnitude of impacts in the New Madrid Floodway Basin are nearly double those in the St. Johns River Basin.

INTRODUCTION

Flood control measures are being considered for the St. Johns Bayou and New Madrid Floodway basins, located in southeast Missouri. Measures include channel excavation in the St. Johns Basin, closing the gap in the levee at the outlet of the New Madrid Floodway, and construction of two pumping stations to help drain interior water. The possible environmental impacts of these changes are to be evaluated and reported in a Supplemental Environmental Impact Statement (SEIS) to the original St. Johns Bayou - New Madrid Floodway project EIS.

The St. Johns Bayou drainage basin encompasses 450 square miles, extending from Commerce and Benton, Missouri to New Madrid, Missouri. The basin is separated from its natural outlet at the Mississippi River by levees which form a sump that is drained by a gravity outlet when the Mississippi River elevation is lower than the interior elevation. Closure of the gates protects the interior from high Mississippi River stages.

The Birds Point-New Madrid Floodway is designed to convey part of the Mississippi River flow during extreme floods, thereby reducing stages at Cairo, Illinois. It has been opened once, during the flood of 1937. The Floodway extends from Birds Point to New Madrid and lies between the Birds Point-New Madrid setback levee and the Mississippi River mainline levee. The area of the Floodway drainage basin is approximately 183 square miles. Unlike St. Johns Bayou, the New Madrid Floodway is frequently flooded from Mississippi River backwater through a 1,500 ft. wide opening of the levee at New Madrid that is designed to serve as an outlet during Floodway operation.

OBJECTIVES

During February-May, operation of the project pump station may lower water surface elevations more than currently exist in the sump areas of St. Johns Bayou and New Madrid Floodway. In addition, channel excavation in St. Johns drainage will alter structural and morphological features of the stream channels and closure of the levee will isolate the floodplain from the Mississippi River. The objective of this document, which serves as an appendix to the SEIS, is to quantify impacts of the project on floodplain and river fish habitats using the Habitat Evaluation Procedure (HEP).

METHODS

The Habitat Evaluation Procedure (HEP) was used to quantify impacts of the project on fish habitat (USFWS 1980). An interagency Team helped develop the study approach, select evaluation species, and finalize Habitat Suitability Index (HSI) values that are used to rate the quality of fish habitat. The Team is comprised of biologists from the Missouri Department of Conservation, US Fish and Wildlife Service, US Army Engineer District, Memphis, and US Army Engineer Waterways Experiment Station. The Team agreed that the aquatic evaluation will focus on early life stages (spawning and rearing) of fishés and how reduction of floodplain and instream habitats affect reproductive success.

Evaluation Species

Fishery data from the project area were obtained from the Missouri Department of Conservation, Cape Girardeau Long-Term Resource Monitoring Station, and from recent collections by Southern Illinois University (SIU). Ninety-three species of fish have been collected in the project area (Table 1). Fishes are dominated taxonomically by minnows (19 species), sunfishes (14 species), suckers (13 species), and darters (13 species).

A technique was required to objectively choose evaluation species from a speciose community. Species need to provide broad representation of habitat preferences and reproductive biology, and must be sensitive to the different project impacts. To accomplish this, species (excluding freshwater eel) were grouped into guilds based on substrate used by spawning adults and on characteristic habitat (channel vs floodplain) used by larvae (Table 2). Twelve evaluation species were selected representing over 91% of the fish species in the project area. Furthermore, most of these species are known hosts of unionids that occur in the St. Johns/New Madrid basins (pers.com., Andy Roberts, USFWS, Columbia, MO).

Composition of the fish community varies among the three reaches in the project area (Sheehan et al. 1998): St. Johns Bayou (inclusive of Birds Point-New Madrid Set-back Levee Ditch), St. James Ditch, and New Madrid Floodway (inclusive of East Bayou Ditch and tributaries). Consequently, separate lists of evaluation species were warranted for each reach (Table 3). In some cases, more than one species were selected from a single guild to represent different spawning chronologies. Collectively, the peak reproductive period of most Mississippi River fishes extends from March through June when water temperature ranges from 60-80 °F. Mississippi River fishes exhibit characteristic spawning chronologies: early-season spawners (Mar), mid-season spawners (Apr-May), and late-season spawners (May-Jun). Thus, habitat was quantified for evaluation species only during those months in which they are known to reproduce (Table 3).

Table 1. Fishes of the St. Johns/New Madrid project area and their respective spawning mode and rearing habitat. Numbers for spawning are defined at the end of this table. Numbers for rearing are: 1=channel, 2=floodplain. Exotic species were excluded.

Family and Species	Spawning	Rearing
Petromyzontidae		
Chestnut lamprey (*Ichthyomyzon castaneus*)	5	1
Acipenseridae		
Shovelnose sturgeon (*Scaphirhynchus platorynchus*)	2	1
Polyodontidae		
Paddlefish (*Polyodon spathula*)	2	1
Lepisosteidae		
Spotted gar (*Lepisosteus oculatus*)	3	2
Longnose gar (*L. osseus*)	3	2
Shortnose gar (*L. platostomus*)	3	2
Amiidae		
Bowfin (*Amia calva*)	10	2
Anguillidae		
American eel (*Anguilla rostrata*)	1	.
Clupeidae		
Skipjack herring (*Alosa chrysochloris*)	1	1
Gizzard shad (*Dorosoma cepedianum*)	1	1
Threadfin shad (*D. petenense*)	1	1
Hiodontidae		
Goldeye (*Hiodon alosoides*)	1	1
Mooneye (*H. tergisus*)	1	1
Esocidae		
Grass pickerel (*Esox americanus*)	3	2
Chain pickerel (*Esox niger*)	3	2
Cyprinidae		
Red shiner (*Cyprinella lutrensis*)	6	1
Spotfin shiner (*C. spiloptera*)	6	1
Blacktail shiner (*C. venusta*)	6	1
Mississippi silvery minnow (*Hybognathus nuchalis*)	4	2
Plains minnow (*H. placitus*)	1	1
Ribbon shiner (*Lythrurus fumeus*)	4	2
Speckled chub (*Macrhybopsis aestivalis*)	1	1
Silver chub (*M. storeriana*)	1	1
Golden shiner (*Notemigonus crysocleucas*)	4	2
Emerald shiner (*Notropis atherinoides*)	1	1
River shiner (*N. blennius*)	1	1
Ironcolor shiner (*N. chalybaeus*)	4	2
Weed shiner (*N. texanus*)	4	2
Silverband shiner (*N. shumardi*)	4	1
Mimic shiner (*N. volucellus*)	1	2
Channel shiner (*N. wickliffi*)	1	2
Pugnose minnow (*Opsopoeodus emiliae*)	4	2
Bullhead minnow (*Pimephales vigilax*)	12	1
Bluntnose minnow (*P. notatus*)	12	1
Catostomidae		
River carpsucker (*Carpiodes carpio*)	4	1
Quillback (*C. cyprinus*)	2	1
Blue sucker (*Cycleptus elongatus*)	2	1

Table 1. Continued

Family and Species	Spawning	Rearing
Catostomidae (con't)		
Creek chubsucker (*Erimyzon oblongus*)	4	2
Lake chubsucker (*E. sucetta*)	3/4	2
Northern hogsucker (*Hypentelium nigricans*)	2	1
Smallmouth buffalo (*Ictiobus bubalus*)	3	2
Bigmouth buffalo (*I. cyprinellus*)	3	2
Black buffalo (*I. niger*)	3	2
Spotted sucker (*Minytrema melanops*)	2	1
River redhorse (*Moxostoma carinatum*)	2	1
Golden redhorse (*M. erythrurum*)	2	1
Shorthead redhorse (*M. macrolepidotum*).	2	1
Ictaluridae		
Black bullhead (*Ameiurus melas*)	12	2
Yellow bullhead (*A. natalis*)	12	2
Blue catfish (*Ictalurus furcatus*)	12	1
Channel catfish (*I. punctatus*)	12	1
Tadpole madtom (*Noturus gyrinus*)	12	2
Freckled madtom (*N. nocturnus*)	12	1
Flathead catfish (*Pylodictis olivaris*)	12	1
Aphredoderidae		
Pirate perch (*Aphredoderus sayanus*)	12	2
Cyprinodontidae		
Golden topminnow (*Fundulus chrysotus*)	3	2
Blackstripe topminnow (*F. notatus*)	3	2
Blackspotted topminnow (*Fundulus olivaceus*)	3	2
Poeciliidae		
Western mosquitofish (*Gambusia affinis*)	13	.
Atherinidae		
Brook silverside (*Labidesthes sicculus*)	3/4	2
Inland silverside (*Menidia beryllina*)	3/4	2
Percichthyidae		
White bass (*Morone chrysops*)	2	1
Yellow bass (*M. mississippiensis*)	2	1
Striped bass (*M. saxatilis*)	2	1
Centrarchidae		
Shadow bass (*Ambloplites ariommus*)	11	2
Flier (*Centrarchus macropterus*)	11	2
Green sunfish (*Lepomis cyanellus*)	11	2
Warmouth (*L. gulosus*)	11	2
Orangespotted sunfish (*L. humilis*)	11	2
Bluegill (*L. macrochirus*)	11	2
Redear sunfish (L. *microlophus*)	11	2
Longear sunfish (*L. megalotis*)	11	2
Redspotted sunfish (*L. miniatus*)	11	2
Smallmouth bass (*Micropterus dolomieu*)	9	1
Spotted bass (*M. punctulatus*)	11	2
Largemouth bass (*M. salmoides*)	11	2
White crappie (*Pomoxis annularis*)	11	2
Black crappie (*P. nigromaculatus*)	11	2

Table 1. Concluded

Family and Species	Spawning	Rearing
Elassomatidae		
Banded pygmy sunfish (*Elassoma zonatum*)	3	2
Percidae		
Mud darter (*Etheostoma asprigene*)	3/4	2
Bluntnose darter (*E. chlorosomum*)	3/4	2
Slough darter (*E. gracile*)	3/4	2
Harlequin darter (*E. histrio*)	2/4	1
Johnny darter (*E. nigrum*)	12	1
Cypress darter (*E. proeliare*)	3	2
Logperch (*Percina caprodes*)	4	1
Blackside darter (*P. maculata*)	2/4	1
Saddleback darter (*P. ouachitae*)	2/4	1
Dusky darter (*P. sciera*)	2/4	1
River darter (*P. shumardi*)	4	1
Sauger (*Stizostedion canadense*)	2	1
Walleye (*S. vitreum*)	2	1
Sciaenidae		
Freshwater drum (*Aplodinotus grunniens*)	1	1

Reproductive modes of fishes of the St. Johns/New Madrid project area based on Balon (1984).

		Number
	NONGUARDERS	
Open substratum spawners	Pelagophils (water column)	1
	Lithophils (rock and gravel)	2
	Phytophils (plants)	3
	Litho-Psammophils (sand/gravel)	4
Brood hiders	Lithophils (rocks and gravel)	5
	Speleophils (crevices)	6
	GUARDERS	
Substratum choosers	Lithophils	7
	Phytophils	8
Nest Spawners	Lithophils	9
	Phytophils	10
	Litho-Psammophils	11
	Speleophils	12
	BEARERS	
Internal Bearers	Viviparous	13

Table 2. Guilds of fish species that occur in the St. Johns/New Madrid Project area. An asterisk indicates recommended evaluation species. Multiple species within a guild cell having different spawning chronologies (see Table 3).

Pelagophils	Lithophils	Phytophils	Litho-Psammophils	Speleophils
		Rear Primarily in River Channel		
Skipjack herring Gizzard shad Threadfin shad Goldeye Mooneye Plains minnow Silver chub Speckled chub Emerald shiner River shiner **Freshwater drum***	Shovelnose sturgeon Paddlefish Quillback Blue sucker Northern hog sucker Spotted sucker River redhorse Golden redhorse Shorthead redhorse **White bass*** Yellow bass Striped bass Smallmouth bass Sauger Walleye Chestnut lamprey		Silverband shiner River carpsucker Harlequin darter Logperch Blackside darter Saddleback darter Dusky darter River darter	Red shiner Spotfin shiner **Blacktail shiner*** Bullhead minnow Bluntnose minnow Blue catfish Flathead catfish **Channel catfish*** Freckled madtom Tadpole madtom Johnny darter
		Rear Primarily in Floodplain		
Mimic shiner* Channel shiner		Spotted gar Longnose gar Shortnose gar Bowfin Grass pickerel Chain pickerel **Smallmouth buffalo*** Bigmouth buffalo Black buffalo **Golden topminnow*** Blackstripe topminnow Blackspotted topminnow Banded pygmy sunfish Mud darter Bluntnose darter Slough darter **Cypress darter*** Brook silverside Inland silverside	MS silvery minnow Ribbon shiner Golden shiner Ironcolor shiner Weed shiner Pugnose minnow Creek chubsucker Shadow bass Flier Green sunfish Warmouth Orangespotted sunfish Bluegill **Longear sunfish*** Redear sunfish Redspotted sunfish Spotted bass **Largemouth bass*** **White crappie*** Black crappie	Black bullhead Yellow bullhead **Pirate perch***

Table 3. List of evaluation species used in the Habitat Evaluation Procedure. Species are separated into rivers/basins based on occurrence and relative abundance. For floodplains, reproductive chronology is indicated as early season (March), mid-season (1 Apr-15 May), and late season (16 May-30 Jun). Spawning (S) and/or rearing (R) are denoted.

Evaluation Species	River			Floodplain					
	St. Johns/Setback Levee Ditch	St. James Ditch	New Madrid Floodway	St. Johns Basin			New Madrid Basin		
				Early	Mid	Late	Early	Mid	Late
Channel catfish	S&R		S&R			S&R			S&R
Smallmouth buffalo	S&R		S&R		S&R			S&R	
Blacktail shiner	S&R	S&R	S&R			S&R			S&R
Mimic shiner	S&R	S&R	S&R			R			R
White bass	S&R		S&R	R			R		
Golden topminnow		S&R				S&R			
Pirate perch		S&R			S&R				
Longear sunfish	S&R	S&R	S&R			S&R			S&R
White crappie		S&R	S&R		S&R			S&R	
Largemouth bass[1]					S&R				
Cypress darter		S&R		S&R					
Freshwater drum	S&R		S&R		R			R	

[1]Spawns and rears in floodplain only

Delineation of Floodplain and River Bank Habitats

HSI values were used to rate the quality of five floodplain and six riverbank habitats for each evaluation species:

Floodplain Habitats
1. Seasonally inundated agricultural land
2. Seasonally inundated fallow and herbaceous marsh land
3. Seasonally inundated bottomland hardwoods
4. Oxbow lakes or other large(>1-acre) permanent waterbodies seasonally connected to the mainstem river
5. Small, permanent backwaters (scatters, brakes, and tributary mouths) seasonally connected to the mainstem river.

Riverbank Habitats (see Appendix I for definitions)

1. Logs and Debris
2. Live Trees
3. Rip-Rap
4. Undercut Banks
5. Bank indentations
6. Aquatic vegetation

Spawning and rearing were evaluated separately in the portion of the floodplain that corresponds to the 2-year frequency flood (Table 3). Spawning, the deposition and incubation of eggs, has specific hydrologic requirements in the floodplain: duration of flooding must be 8 days and depth of flooding must be 1 foot. A minimum depth of 1 foot is considered necessary for adult fishes to move onto the floodplain. Duration of flooding is important for egg incubation since eggs can be stranded and desiccate if water levels drop before hatching. Incubation times range from 1-14 days for most Mississippi River fishes, but documented incubation times for most of the evaluation species are $\leq$ 8 days. A flood duration of 8 days then is environmentally conservative because it emphasizes longer development times, provides a margin for temporal variation in spawning activities (adult movement onto the floodplain, nest construction and guarding, dispersal of fry). Rearing includes yolk-sac and post yolk-sac larval phases. Larval fish can potentially use any area of the inundated floodplain regardless of flood duration, so no hydrologic restrictions were used to delineate rearing habitat

The Memphis District used a Geographical Information System (GIS) and satellite imagery to delineate floodplain habitats based on their position (e.g., river mainstem, floodplain), land use (e.g., agriculture, fallow), and vegetation (e.g., bottomland hardwoods). Pre-project acres of each floodplain habitat were calculated from stage-area curves and imagery that depicts a flood occurring every 2 years. For post-project conditions (alternatives), reduction in stage elevation was estimated and difference between pre- and post-project acres calculated by habitat.

In the rivers, spawning and rearing were combined into a single value. Acres of each riverbank habitat were quantified up to top bank. Riverbank habitats were delineated from field surveys and acres of each riverbank habitat were used to calculate impacts. Transects were located in representative reaches of each river that will be excavated and habitats were mapped along 2-3 longitudinal transects per reach.:

a. 4.5 miles of St. Johns Bayou (both banks)

b. 10.8 miles along St. James Ditch - Habitat was quantified along the left bank, and along the right bank between Highway 00 and Highway 80 (see Avoid and Minimize alternative below). In addition, survey results of St. James Ditch above Lateral Ditch #2 at East Prairie was reported separately in order to emphasize the aquatic vegetation that occurs in the upper reach.

c. 12.4 miles along Birds Point-New Madrid Setback Levee Ditch (left bank) - No structure was identified except live trees from the bank to the toe of the levee; acres of these trees were determined from satellite imagery to provide a more accurate estimate.

d. East Bayou (Mud) Ditch - Although channel enlargement will not occur in this stream, the levee closure will affect fish access from the Mississippi River. Consequently, riverbank habitats were quantified for the lower reach to characterize existing habitat conditions.

At each transect location, a 150-foot rope marked in 3 ft intervals was positioned parallel to the riverbank. Each habitat type was identified and its length and width measured. The area was recorded as straight lines (i.e., either a rectangle or square) on graph paper. When multiple structures were closely spaced, the outside boundary of the entire cluster was delineated and the dominant habitat type identified. Although using straight lines to delineate irregular shapes may result in an overestimate of the actual dimensions of the structure, it accounts for velocity refugia provided by the structure. Mean area of each structural feature was determined by reach, multiplied by the length of the reach (one bank or two banks), and converted to acres. Acres of each habitat type obtained through surveys were used as the pre-project area variable. We assumed that acres will remain the same for post-project, but the HSI score will be for "no structure."

Habitat Suitability Index Values

Habitat Suitability Index (HSI) values, ranging from 0 (unsuitable habitat value) to 1 (optimal habitat value), are presented for spawning and rearing in the river (Table 4), spawning in the floodplain (Table 5), and rearing in the floodplain (Table 6). Except for aquatic vegetation, HSI values for six of the evaluation species were previously developed by consensus of an interagency team of biologists (Delphi technique) supplemented by field data from tributaries of the lower Mississippi River: smallmouth buffalo, channel catfish, largemouth bass, white crappie, blacktail shiner, and freshwater drum. HSI values for aquatic vegetation, and for all habitats for the 6 additional species, were estimated from species accounts (Pflieger, 1975; Robison and Buchanan, 1988; Etnier and Starnes, 1993), data on larval and juvenile fishes in southern forested wetlands (Killgore and Baker, 1996; Hoover and Killgore, 1998; unpublished data), and by iterative consensus of HEP team members. Largemouth bass was not included in the riverbank evaluation because this species is reported to spawn in backwaters or floodplains. Three species (mimic shiner, white bass, freshwater drum) were excluded from the floodplain spawning evaluation because they spawn in river channels.

Table 4. HSI scores of riverbank habitats for combined spawning and rearing of evaluation fish species.

Species	Riverbank Habitats							
	LD	LT	RIP	UB	BKI	SB	AV	NS
Channel catfish	.90	.49	.65	.85	.75	.35	.20	.04
Smallmouth buffalo	.46	.56	.29	.19	.23	.59	.90	.04
Blacktail shiner	.91	.61	.50	.67	.58	.60	0.5	.03
Mimic Shiner	.40	.80	.55	.25	.70	.90	1.0	.50
White Bass	.25	.50	.88	.25	.25	.75	.25	.50
Golden topminnow	.25	.50	.30	.25	.75	.25	1.0	.10
Pirate perch	1.0	.75	.63	.25	.25	.25	1.0	.10
Longear sunfish	.53	.50	.63	.18	.75	1.0	.50	.50
White crappie	.65	.58	.34	.18	.33	.25	.25	.13
Cypress darter	.75	.75	.30	.10	.50	.25	1.0	.10
Freshwater drum	.38	.46	.76	.28	.20	.36	.20	.72

LD=Logs and Debris
LT=Live trees
RIP=Rip-rap (revetment)
UB=Undercut banks
BKI=Bank indentations
SB=Sandbars
AV=Aquatic vegetation
NS=No structure

Table 5. HSI scores for spawning of fish evaluation species in the floodplain.					
SPECIES	FLOODPLAIN HABITATS				
	CAG	FALLOW	BLH	OXBOW	SBT
Channel catfish	0.13	0.24	0.74	0.86	0.87
Smallmouth buffalo	0.42	0.8	0.85	0.9	0.89
Blacktail shiner	0.05	0.15	0.59	0.7	0.75
Golden topminnow	0.05	0.75	0.75	1.0	1.0
Pirate perch	0.05	0.50	1.0	1.0	1.0
Longear sunfish	0.50	0.75	0.75	1.0	1.0
White crappie	0.25	0.64	0.74	0.96	0.93
Largemouth bass	0.19	0.51	0.86	0.98	0.97
Cypress darter	0.05	0.75	1.0	0.75	0.75

CAG = Cultivated Agricultural Land
FALLOW = Fallow Land
BLH = Bottomland Hardwoods
OXBOW = Oxbow Lake
SBT = Scatters, Brakes, and Tributary mouths

Table 6. HSI scores for rearing (larvae) of fish evaluation species in the floodplain.

SPECIES	FLOODPLAIN HABITATS				
	CAG	FALLOW	BLH	OXBOW	SBT
Channel catfish	0.0	0.0	0.25	0.5	0.75
Smallmouth buffalo	0.17	0.10	0.10	1.0	0.50
Blacktail shiner	0.05	0.05	0.10	0.25	1.0
Mimic shiner	0.05	0.50	0.75	0.75	0.75
White bass	1.0	0.75	0.5	1.0	0.5
Golden topminnow	0.0	0.25	0.75	1.0	1.0
Pirate perch	0.0	0.25	1.0	1.0	1.0
Longear sunfish	0.50	0.50	0.75	1.0	1.0
White crappie	0.10	0.10	0.1	1.0	0.50
Largemouth bass	0.15	0.25	0.25	1.0	1.0
Cypress darter	0.0	0.75	1	0.75	0.75
Freshwater drum	0.10	0.20	0.5	0.2	0.2

CAG = Cultivated Agricultural Land   OXBOW = Oxbow Lake
FALLOW = Fallow Land   SBT = Scatters, Brakes, and Tributary mouths
BLH = Bottomland Hardwoods

Impact Analysis

HSI values were multiplied by area (acres of floodplain or riverbank habitats) to express project alternatives as Habitat Units (HU) according to the following equation:

$$HU = HSI \times AREA$$

Cumulative HSI and HU values were used to express the results since the evaluation species represented the entire community of fishes that are susceptible to project impacts. Three alternatives were evaluated using the Habitat Evaluation Procedure: No Action (Existing Conditions), Authorized Project, and Avoid and Minimize. The analyses and reporting of results were separated by basin: St. Johns Bayou and New Madrid Floodway. A description of the each alternative is provided below.

A. No Action Alternative: Project as it exists at this time.

B. Authorized Project Alternative involves the following construction items:

1. St. Johns Bayou/Setback Levee Ditch
   a. 4.5 miles of St. Johns Bayou will be enlarged on both banks with a 200 ft bottom width.
   b. 12.4 miles of Birds Point-New Madrid Setback Levee Ditch will be enlarged along the left bank with a 50 ft bottom width and will include removal of all trees along the toe of the levee.
   c. Construction of a 1,000 cfs pumping station located about 600 feet east of the existing gravity outlet at the lower end of St. Johns Bayou. This will evacuate water which now ponds at the lower end of St. Johns Bayou basin whenever the gravity gates are closed.

2. St. James Ditch
   a. 10.8 miles of St. James Ditch will be enlarged from the left bank. A 45 ft bottom width is planned for approximately 3 miles, after which the bottom width will be 25 ft.

3. New Madrid Floodway
   a. Closure of the 1,500 foot gap in the Mississippi River levee at the lower end of the New Madrid Floodway. This will eliminate Mississippi River backwater flooding in the Floodway. Construction of the levee will eliminate 3.4 acres of floodplain habitat.
   b. Construction of a combined gravity outlet structure and a 1,500 cfs pumping station at the levee gap closure. This will evacuate interior runoff water and eliminate flooding whenever the gravity gates are closed.

C. Avoid and Minimize alternative incorporates the following modifications to the authorized items:

1. St. Johns Bayou
   a. The lower 4.5 miles of the Bayou will be enlarged only on the left descending bank with a 120 ft bottom width.
   b. Transverse dikes, initially recommended and designed by the Missouri Department of Conservation, will be placed once every ½ mile along alternating banks in the lower 4.0 miles of St. Johns Bayou. Each dike will be 2-3 ft high, extend approximately 30 ft into the channel (¼ of channel width), slope from topbank down, and armored with rip-rap (approximately 2,800 ft^2 per dike). Dikes will provide stable substrate for invertebrate and fish colonization and create slackwater and plunge pools in the Bayou.
   c. Increase the start and stop pump elevations to 282 ft and 280 ft, respectively.

2. St. James Ditch
   a. Work will switch to the right descending bank for 3.3 miles between Hwy 80 and Hwy 00 to avoid large trees on embankment.
   b. The upper 3.7 miles of St. James Ditch will be a no-work reach to protect the aquatic vegetation that provides habitat for the golden topminnow (*Fundulus chrysotus*).

3. New Madrid Floodway
   a. Increase the start and stop pump elevations to 282.5 ft and 280 ft, respectively.

RESULTS AND DISCUSSION

Riverbank Habitat

A total of 60.57 acres of riverbank and in-channel structure will be removed in the St. Johns Basin under the Authorized alternative (Table 7) resulting in a net loss of 145 HU's (Table 8). Live trees and aquatic vegetation are the most common structural features that will be removed. The majority of live trees were willows (*Salix sp.*), cottonwoods, and water elm. Live trees are most prevalent along the left descending bank of the Levee Ditch; approximately 19 acres of trees are growing 50-125 feet from the water's edge. In St. James Ditch above Highway 525, over 30 acres of aquatic vegetation comprised of *Elodea* sp. and *Polygonum* sp. (smartweed) will be removed in the Authorized Alternative. Other forms of riverbank structure (undercut banks, rip-rap, bank indentations) were not noted during the survey.

A total of 36.17 acres of structure will be removed under the Avoid and Minimize alternative resulting in a net loss of 58 HU's. This alternative reduces habitat losses by 60% compared to the authorized alternative. In St. Johns Bayou, 1.6 acres of structure will be removed by working the left bank only compared to a loss of 2.8 acres for the Authorized alternative. In St. James Ditch, 4 acres of trees will be preserved by switching banks between Highway 00 and Highway 80, and 18.83 acres of aquatic vegetation will be avoided by designating the upper 3.7 miles as a no work reach.

The Avoid and Minimize alternative includes the construction of dikes in St. Johns Bayou to offset losses due to removal of riverbank structure. Dikes function as current defectors, and when placed along alternating banks in straight channels, they may reestablish a meander pattern during low flows, recreate a pool-riffle sequence, and contribute to channel stabilization (Swales 1989). In addition, dikes provide two types of riverbank habitat that can be quantified using HEP: rip-rap and bank indentations (see Appendix I for definitions). A total of nine dikes will be placed along alternating banks in the lower 4 miles of St. Johns resulting in the following gain in HU's that fully compensate the 2.5 HU's lost under the Avoid and Minimize alternative (Table 8):

Habitat	Area per Dike[1] (ft^2)	Total Area (Acres)	Cumulative HSI[2]	HU's Gained
Rip-rap	2,800	0.58	4.26	2.5
Bank Indentations -slackwater and plunge pools)	1,500	0.31	3.46	1.1
				3.6

[1]Calculated by CEMVM
[2]All species designated for St. Johns Bayou

Table 7. Acres of riverbank and in-channel structure that will be removed in the St. Johns basin. Types of structure are LD - Logs and Debris, LT - Live Trees, AV - Aquatic vegetation, and NS - No structure.

Basin/River	Bank	River Miles	Acres LD	Acres LT	Acres AV	Acres NS	Total Acres of Structure
			Authorized Alternative				
St. Johns Bayou	Both Banks	1.0-4.5	0.41	2.39	0.0	32.97	2.80
Lower St. James Ditch	Left	0.0-7.1	0.33	4.99	13.74	22.52	19.06
Upper St. James Ditch	Left	7.1-10.8	0.06	0.09	18.83	1.59	18.98
Levee Setback Ditch	Left	0.0-12.4	0.0	19.73	0.0	197.2	19.73
							60.57
			Avoid and Minimize Alternative				
St. Johns Bayou	Left	1.0-4.5	0.34	1.25	0.0	18.09	1.59
St. James Ditch between Mouth and HWY 00	Left	0.0-2.02	0.0	0.21	0.0	3.00	0.21
St. James Ditch between HWY 00 and HWY 525	Right	2.02-4.4	0.0	0.61	0.0	4.13	0.61
St. James Ditch between HWY 525 and HWY 80	Right	4.4-5.55	0.0	0.29	5.85	1.83	6.14
St. James Ditch between HWY 80 and Lateral #2	Left	5.55-7.1	0.0	0.0	7.89	2.47	7.89
Levee Setback Ditch	Left	0.0-12.4	0.0	19.73	0.0	197.20	19.73
							36.17

Table 8. Reduction of riverbank Habitat Units in the St. Johns Basin. Lateral #2 separates upper and lower St. James Ditch.

Riverbank Structure	Spawning and Rearing					
	Acres Lost	Cumulative HSI[1]	HU's Lost	HU's Gained[2]		Net Loss in HU's
				$\sum HSI_{NS}$	HU	
	St. Johns Bayou (Both Banks) - Authorized Alternative					
Logs and Debris	0.41	3.83	1.6	2.33	0.9	0.7
Live Trees	2.39	3.92	9.4	2.33	5.6	3.8
Aquatic Vegetation	0.00	3.55	0.0	2.33	0.0	0.0
Total	2.80	-	11.0	-	6.5	4.5
	St. Johns Bayou (Left Bank) - Avoid and Minimize Alternative					
Logs and Debris	0.34	3.83	1.3	2.33	0.8	0.5
Live Trees	1.25	3.92	4.9	2.33	2.9	2.0
Aquatic Vegetation	0.00	3.55	0.0	2.33	0.0	0.0
Total	1.59	-	6.2	-	3.7	2.5
	Upper St. James Ditch (Left Bank) - Authorized Alternative					
Logs and Debris	0.06	4.49	0.27	1.46	0.09	0.18
Live Trees	0.09	4.49	0.40	1.46	0.13	0.27
Aquatic Vegetation	18.83	5.25	98.9	1.46	27.49	71.41
Total	18.98	-	99.57	-	27.71	71.86
	Lower St. James Ditch (Left Bank) - Authorized Alternative					
Logs and Debris	0.33	4.49	1.48	1.46	0.48	1.0
Live Trees	4.99	4.49	22.4	1.46	7.28	15.12
Aquatic Vegetation	13.74	5.25	72.13	1.46	20.06	52.07
Total	19.06	-	96.01	-	27.82	68.19
	Lower St. James (Alternating Banks)-Avoid & Minimize Alternative					
Logs and Debris	0.00	4.49	0.00	1.46	0.00	0.00
Live Trees	1.11	4.49	4.98	1.46	1.62	3.36
Aquatic Vegetation	13.74	5.25	72.13	1.46	20.06	52.07
Total	14.85	-	77.11	-	21.68	55.43

Table 8. Concluded						
	Levee Setback Ditch					
Logs and Debris	0.00	3.83	0.00	2.33	0.00	0.00
Live Trees	19.73	3.92	77.34	2.33	45.97	31.37
Aquatic Vegetation	0.00	3.55	0.00	2.33	0.00	0.00
Total	19.73	-	77.34	2.33	45.97	31.37

[1] Cumulative HSI for all evaluation species selected for the respective river.
[2] HU's gained are cumulative HSI for No Structure (NS) multiplied by acres lost.

Floodplain Habitat

An average of 3070 acres of rearing habitat is inundated at least once every two years during the reproductive season (Mar-Jun) in the St. Johns Basin (Table 9). Of the 3070 acres, an average of 1592 acres (52%) is inundated greater than or equal to 8 days with depth of flooding greater than or equal to 1 ft (i.e., spawning acres). In the New Madrid Floodway, an average of 4231 rearing acres is inundated during March-June, 2179 (52%) of which is spawning acres (Table 10). In both basins, flooded acres are highest in March, lowest in late May and June. Agricultural land and bottomland hardwoods are the most common floodplain habitat in both basins, whereas fallow land and large, permanent waterbodies are the least common (Tables 11 and 12).

Both alternatives reduced average acres flooded in both basins, but losses were slightly less for the Avoid and Minimize alternative (Tables 9 and 10). Loss in Habitat Units were highest for agricultural land and bottomland hardwoods in both basins (Tables 11 and 12). Average rearing acres in the St. Johns Basin, representing 3657 HU's, will be reduced to 1602 acres for the Authorized alternative and 1705 acres for the Avoid and Minimize alternative, resulting in 47% and 42% loss of HU's, respectively (Table 9). Average spawning acres, representing 1844 HU's, will be reduced to 730 acres for the Authorized alternative and 786 acres for the Avoid and Minimize alternative, resulting in a 54% and 49% loss of HU's, respectively.

Floodplain impacts in the New Madrid Floodway Basin were substantially higher. Average rearing acres, representing 3174 HU's, will be reduced to 116 acres for the Authorized alternative and 307 acres for the Avoid and Minimize alternative, resulting in 97% and 91% loss of HU's, respectively (Table 10). Average spawning acres, representing 1763 HU's, will be reduced to 49 acres in the Authorized alternative and 121 acres in the Avoid and Minimize alternative, resulting in 97% and 91% loss of HU's, respectively. The Avoid and Minimize alternative, then, reduces the loss of floodplain habitats by approximately 5% in both basins, but magnitude of impacts in the New Madrid Floodway Basin are nearly double those in the St. Johns River Basin.

In the Avoid and Minimize alternative, the gravity gates at the levee gap closure will remain open until the Mississippi River gage at New Madrid reaches 27 ngvd, which corresponds to an elevation of 282.5 ft in the New Madrid Floodway and St. Johns Basins. Based on the period of record, the number of days that the gage is ≤ 27 is 14.3 and 12.9 in March and April, respectively. Therefore, the gates will be open periodically during the spawning season and allow fish to move between the Mississippi River and the two basins. Although river and inundated floodplain habitats that remain in the basins after the project is completed can be utilized for spawning and rearing, the extent of fish movement through the box culverts is unknown.

Table 9. Total number of floodplain acres and Habitat Units (HU) for each alternative in the St. Johns Basin, and percent loss in HU's for each alternative compared to existing conditions. Habitat Units are cumulative for evaluation species that are present during the respective spawning or rearing period.						
Alternative/Month	Spawning			Rearing		
	Acres	HU	Percent HU's Lost	Acres	HU	Percent HU's Lost
Existing						
1-30 March	2179.6	843	.	4006.7	4734	.
1 Apr - 15 May	1983.3	3687	.	3847.5	4221	.
16 May - 30 Jun	612.4	1002	.	1355.4	2015	.
Average	1591.8	1844	.	3069.9	3657	.
Authorized						
1-30 March	1028.3	412	51	2243.3	2663	44
1 Apr - 15 May	887.7	1709	54	1877.9	2140	49
16 May - 30 Jun	273.2	448	55	684.8	1012	50
Average	729.7	856	54	1602.0	1938	47
Avoid and Minimize						
1-30 March	1118.0	462	45	2367.4	2822	40
1 Apr - 15 May	945.9	1857	50	2004.2	2337	45
16 May - 30 Jun	294.1	499	50	744.3	1142	43
Average	786.0	939	49	1705.3	2100	43

3 Nov 98

Table 10. Total number of floodplain acres and Habitat Units (HU) for each alternative in the New Madrid Floodway, and percent loss in HU's for each alternative compared to existing conditions. Habitat Units are cumulative for evaluation species that are present during the respective spawning or rearing period.

Alternative/Month	Spawning			Rearing		
	Acres	HU	Percent HU's Lost	Acres	HU	Percent HU's Lost
Existing						
1-30 March	3110.7	.	.	5433.7	4719	.
1 Apr - 15 May	2685.7	2653	.	5612.2	2997	.
16 May - 30 Jun	741.4	872	.	1646.5	1806	.
Average	2179.3	1763	.	4230.8	3174	.
Authorized						
1-30 March	70.8	.	.	132.1	96	98
1 Apr - 15 May	40.9	56	98	109.7	74	98
16 May - 30 Jun	36.3	61	93	105.7	161	91
Average	49.3	59	97	115.8	110	97
Avoid and Minimize						
1-30 March	155.4	.	.	359.3	267	94
1 Apr - 15 May	127.9	181	93	349.5	278	91
16 May - 30 Jun	80.9	139	84	212.7	339	81
Average	121.4	160	91	307.2	295	91

3 Nov 98

Table 11. Summary of floodplain acres inundated for a 2-year frequency flood and associated Habitat Units in the St. Johns Basin for each alternative. Habitat Units are cumulative for evaluation species that are present during the respective spawning or rearing period.

Alternative/Habitat	Spawning						Rearing					
	March		1 Apr - 15 May		16 May - 30 Jun		March		1 Apr - 15 May		16 May - 30 Jun	
	Acres	HU	Acres	HU	Acres	HU	Acres	HU	Acres	HU	Acres	HU
Existing												
Agricultural Land	1323.1	66.2	1204.8	1096.4	347.5	253.7	2461.3	2461.3	2356.9	1225.6	785.9	471.5
Fallow Land	158.6	119.0	144.1	353.0	45.8	86.6	290.3	435.5	278.4	250.6	100.2	130.3
Bottomland Hardwoods	539.1	539.1	492.5	1699.1	165.6	468.6	977.4	1466.1	943.4	1839.6	357.7	930.0
Large Permanent Waterbodies	27.4	20.6	24.1	92.5	9.3	33.1	47.2	82.6	45.4	190.7	19.0	66.5
Small Permanent Waterbodies	131.4	98.6	117.8	446.5	44.2	160.0	230.5	288.1	223.4	714.9	92.6	416.7
Authorized												
Agricultural Land	607.7	30.4	516.8	470.3	155.4	113.4	1353.6	1353.6	1111.6	578.0	402.5	241.5
Fallow Land	76.0	57.0	66.5	162.9	20.2	38.2	164.2	246.3	138.9	125.0	49.8	64.7
Bottomland Hardwoods	263.5	263.5	230.2	794.2	71.4	202.1	561.1	841.7	479.8	935.6	173.4	450.8
Large Permanent Waterbodies	15.7	11.8	14.7	56.4	5.2	18.5	31.5	55.1	28.7	120.5	11.2	39.2
Small Permanent Waterbodies	65.4	49.1	59.5	225.5	21.0	76.0	132.9	166.1	118.9	380.5	47.9	215.6
Avoid and Minimize												
Agricultural Land	643.3	32.2	537.7	489.3	160.5	117.2	1401.7	1401.7	1160.5	603.5	422.2	253.3
Fallow Land	82.7	62.2	70.7	173.2	21.8	41.2	173.2	259.8	148.3	133.5	54.4	70.7
Bottomland Hardwoods	295.7	295.7	252.7	871.8	80.4	227.5	606.9	910.4	526.3	1026.3	196.5	510.9
Large Permanent Waterbodies	18.6	14.0	16.5	63.4	6.1	21.7	35.6	62.3	32.7	137.3	13.6	47.6
Small Permanent Waterbodies	77.7	58.3	68.3	258.9	25.3	91.6	150.0	187.5	136.4	436.5	57.6	259.2

Table12. Summary of floodplain acres inundated for a 2-year frequency flood and associated Habitat Units in the New Madrid Floodway for each alternative. Habitat Units are cumulative for evaluation species that are present during the respective spawning or rearing period. Based on the evaluation species selected, there are no spawning HU's in March.

Alternative/Habitat	Spawning						Rearing					
	March		1 Apr - 15 May		16 May - 30 Jun		March		1 Apr - 15 May		16 May - 30 Jun	
	Acres	HU	Acres	HU	Acres	HU	Acres	HU	Acres	HU	Acres	HU
Existing												
Agricultural Land	2075.0	.	1789.2	1198.8	474.3	322.5	3644.6	3644.6	3765.8	1393.3	1063.7	638.2
Fallow Land	184.2	.	158.8	228.7	44.3	50.5	321.0	240.8	331.7	132.7	98.1	103.0
Bottomland Hardwoods	612.9	.	528.6	840.5	153.0	318.2	1059.6	529.8	1099.1	769.4	342.2	633.0
Large Permanent Waterbodies	116.5	.	101.8	188.0	31.9	81.7	199.3	199.3	202.7	445.9	67.2	167.9
Small Permanent Waterbodies	122.1	.	108.0	255.5	37.9	99.3	209.2	104.6	212.9	255.5	75.4	263.8
Authorized												
Agricultural Land	29.5	.	10.6	7.1	10.8	7.3	51.3	51.3	31.9	11.8	39.4	23.6
Fallow Land	4.4	.	2.7	3.9	2.4	2.7	9.1	6.8	8.1	3.2	7.1	7.5
Bottomland Hardwoods	28.1	.	22.9	36.4	18.5	38.5	53.7	26.9	54.0	37.8	44.8	82.9
Large Permanent Waterbodies	2.2	.	0.3	0.6	1.0	2.6	4.1	4.1	2.8	6.2	3.8	9.5
Small Permanent Waterbodies	6.6	.	4.4	8.0	3.6	9.4	13.9	7.0	12.9	15.5	10.6	37.1
Avoid and Minimize												
Agricultural Land	47.3	.	28.3	19.0	22.1	15.0	124.1	124.1	111.1	41.1	76.1	45.7
Fallow Land	12.1	.	10.7	15.4	6.2	7.1	25.6	19.2	25.5	10.2	14.9	15.6
Bottomland Hardwoods	67.5	.	64.6	102.7	38.0	79.0	128.8	64.4	131.9	92.3	79.0	146.2
Large Permanent Waterbodies	8.3	.	5.8	10.8	4.3	11.0	37.3	37.3	37.1	81.6	18.3	45.8
Small Permanent Waterbodies	20.2	.	18.5	33.7	10.3	27.0	43.5	21.8	43.9	52.7	24.4	85.4

LITERATURE CITED

Balon, E. K. 1984, Patterns in the Evolution of Reproductive Styles of Fishes. Pages 35-53 in G.W. Potts and R.J. Wootton (eds), Fish Reproduction: Strategies and Tactics, Academic Press, New York.

Etnier, D.A. and W.C. Starnes. The fishes of Tennessee. University of Tennessee Press, Knoxville, 681 pp.

Hoover, J.J. and K.J. Killgore. Fish communities. pp. 237-260 In Southern forested wetlands ecology and management, M.G. Messina and W.H. Conner (ed.s), Lewis Publishers, Boca Raton.

Killgore, K.J. and J.A. Baker. 1996. Patterns of larval fish abundance in a bottomland hardwood wetland. Wetlands 16: 288-295.

Pflieger, W.F. 1975. The fishes of Missouri. Missouri Dept. Conservation, Jefferson, 343 pp.

Robison, H.W. and T.M. Buchanan. 1988. Fishes of Arkansas. University of Arkansas Press, Fayetteville, 536 pp.

Ross, S.T. and J.A. Baker. 1983. The response of fishes to periodic spring floods in a southeastern stream. Am. Midl. Nat. 109: 1-14.

Sheehan, R. J., R.C. Heidinger, and P.S. Wills. 1998 (Draft). St. Johns Basin and New Madrid Floodway Fisheries Survey: Preliminary Summary Report of fishes collected. Cooperative Fisheries Research Laboratory, Southern Illinois University.

Swales, S. 1989. The use of instream habitat improvement methodology in mitigating the adverse effects of river regulation on fisheries. Pages 185-208 in J.A. Gore and G.E. Petts (eds), Alternatives in Regulated River Management, CRC Press, Boca Raton, Florida.

Appendix I. Definition of riverbank habitats.

Logs and Debris - Instream wood in the form of a single log or tree limb with a minimum diameter of 0.25 ft., branches of dead trees, root wads, or log jams with associated debris (small sticks, leaves, etc) that are firmly anchored to the shoreline.

Live Trees - Live trees growing on sandbars or shorelines that are periodically inundated during high water. Single trees with a diameter of less than 0.25 ft are not considered suitable habitat.

Rip-Rap - Stones of variable sizes (0.6-3.2 ft maximum dimension) used to protect river banks from erosion. Rip-rap is usually placed on a graded bank from the top of the river bank to the thalweg and is referred to as revetment. Rip-rap combined with smaller stones may also be used to create gravel bars.

Undercut Banks - Usually associated with areas of erosion and alternating from outside bend to outside bend. Any undercut bank that is submerged during the spawning season in areas not subject to scouring is considered reproductive habitat. Dimensions vary but it was assumed that undercut banks have minimum lengths of 3 ft and extend into the bank 1.5 ft.

Bank Indentation - A low velocity area adjacent to fast-moving water. Indentations are often formed by an open recess or notch extending into the bank. For indentations to function as reproductive habitat, they must extend at least 5 ft into the surrounding riverbank, with a water depth of at least 1.5 ft during the spawning season. In channel structures, such as weirs and dikes, can also create slackwater areas that function similarly to indentations.

No Structure - River banks without any of the above features. Banks without structure are usually comprised of clay substrate without shoreline irregularities.

FILE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
608 East Cherry Street, Room 200
Columbia, Missouri 65201
Phone: (573) 876-1911 Fax: (573) 876-1914

June 7, 2001

Mr. David Reece, Chief
Environmental and Economic Analysis Branch
U.S. Army Corps of Engineers
B-202 Clifford Davis Federal Building
167 North Street
Memphis, Tennessee 38103-1894

Dear Mr. Reece:

Please refer to the April 11, 2001, interagency meeting at the Memphis District Corps of Engineers (Corps) to solicit scoping comments for the revised draft Supplemental Environmental Impact Statement (SEIS) for the St. Johns Bayou and New Madrid Floodway Project, First Phase, located in Mississippi and New Madrid Counties, Missouri. At the meeting the U.S. Fish and Wildlife Service (Service) raised a number of issues that should be considered in the revised draft SEIS. This letter provides further detailed scoping comments to help the Corps as they prepare that draft, and describes the Service's anticipated involvement as a cooperating agency. In the near future, the Service will provide to the Corps a draft Scope of Work detailing both the Service's information needs and schedule to fulfill our reporting requirements under the Fish and Wildlife Coordination Act. The Service submits the following comments pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.). We have coordinated our input with the Missouri Department of Conservation and have incorporated their concerns.

NEPA Issues

The Service has enclosed a list of issues the Corps should thoroughly evaluate and explain in the revised draft SEIS. Some of those are issues we believe remain unresolved from the previous SEIS for the project. Others relate to the analyses of additional alternatives. It is extremely important to maintain a consistent methodology to ensure accurate comparisons between project alternatives. (i.e., each alternative should be evaluated with at least as much detail and rigor as those in the previous NEPA document).

In the initial scoping stages, the Corps should attempt to further refine the preliminary Benefit/Cost Ratios (BCR) estimates for the proposed alternative levee alignments to determine which of those have a BCR equal to or greater than 1, and thus should receive detailed analysis per the Department of the Army's January 19, 2001, letter to the Department of the Interior. In the information contained in the November 16, 2000, Mitigation Options Paper, it is not clear how the Corps developed the estimated BCR figures. Considering the narrow range of BCR values, improving the accuracy of mitigation and floodway cost estimates is critical to ensure that all reasonable, feasible alternatives are carried forward for detailed analysis. The BCR currently considers agriculture benefits foregone with each setback levee alternative. The Service recommends that fish and wildlife benefits (e.g., commercial and recreational fishing, ecotourism, etc.) gained with those alternatives should also be factored into the BCR. Therefore, we recommend the Corps coordinate with the agencies to determine what, if any, further cost/benefits evaluations are needed prior to narrowing the number of alternatives to be evaluated in the revised document.

Previously the Service raised a number of questions regarding the methods used in the hydraulics analyses. The Service provided the Corps a December 1998, assessment by Dr. Robb Jacobson detailing issues important in understanding the hydrologic information presented in the SEIS. The current SEIS includes a brief response to that letter citing a number of documents and correspondence not available to the public. The Service believes the method/data limitations and model sensitivity has yet to be adequately addressed. Because of the importance of the hydrology/hydraulics to both the economic and environmental impacts of the project, the Service recommends a thorough explanation of those methods and data be included in the revised SEIS in the interest of public disclosure.

Although much of the environmental analysis in the previous SEIS focused on project impacts to resources for frequent (i.e., 2-year) floods, the revised document should enlarge that analysis to fully evaluate project-related impacts to fish and wildlife resources during less frequent, yet significant, flood events (i.e., 5, 10, 20-year and a Floodway project-design flood) for each alternative. In addition, the revised SEIS should include a detailed discussion of New Madrid Floodway operations under all project alternatives, and how each alternative affects those operations. Finally, the revised document should detail the rationale for each alternative that was rejected in the previous SEIS for this project, particularly in regards to more rigorous and complete benefit/cost analyses.

Mitigation Objectives

At the April interagency meeting, the Corps expressed some confusion regarding the Service's mitigation objectives for this project. The Service's primary mitigation objective is to avoid degradation or loss of existing fish and wildlife habitat value. Because of the limitations of current ecologic assessment methods and considerable constraints on successful habitat restoration, the Service believes avoiding resource losses is the most effective way to conserve our federal trust resources. When it is necessary to compensate for fish and wildlife habitat losses that are unavoidable, the Service relies on our mitigation policy to ensure that recommended mitigation is commensurate with project-related fish and wildlife resource losses. For example, the Service considers forested wetlands and in-stream habitat such as the St. James Ditch as Category 2 resources; there should be no net loss of in-kind habitat value of such resources. The majority of project area wetlands are pasture, croplands, and fallow fields. Generally such areas are nationally abundant, hence a Category 3 resource requiring no net loss of habitat value while minimizing in-kind habitat loss. In the project area, however, the resource value of those areas is greatly influenced by their periodic connection to the Mississippi River. Because floodplain-tributary complexes closely connected with the Mississippi River are almost absent from the modern lower river system, and help support substantial and diverse floodplain and riverine fisheries, the Service considers such regionally scarce habitats as Category 2 resources. Compensatory mitigation for those resources should ensure continued river-floodplain connectivity and provide no-net loss of in-kind habitat value.

The Corps and the Service used several models to evaluate project-related losses of fish and wildlife habitat. Using those models the Service also developed a number of recommendations to compensate for predicted habitat losses. Those recommendations included compensatory mitigation needs expressed in average annual acres of a particular habitat, assuming optimal hydrology. Often, however, hydrology on potential restoration sites has been significantly altered, limiting the habitat value of those sites. Therefore, to ensure that potential mitigation tracts receive an accurate evaluation consistent with that used to determine project-related habitat losses, each tract must go through a similar site-specific analysis to determine the level of habitat value, and hence, mitigation credit that site will provide. For example, if a potential mitigation tract flooded only 60 percent of the time assumed under our mitigation computations, the acreage at that site must be increased by 40 percent to fully compensate for a given habitat loss.

The suitability of potential mitigation lands will also vary with a species group. For example, restoring forested wetlands can benefit fish and migratory birds. However, in the case of the Floodway portion of the project, losses to floodplain connectivity and riverine fisheries resources can only be compensated with sites that will provide for that connectivity and unimpeded fish access. While a restored forested wetland area may compensate for losses of bottomland hardwoods and many associated species, it would not receive credit towards fisheries mitigation if it was disconnected from the river, especially during critical life stages. In addition, mitigation measures at a particular site should significantly increase the future habitat value of that site. Areas already providing such habitat, would receive minimal credit towards compensatory mitigation needs. Therefore, the Service would not consider batture lands, refuges, conservation management areas, mitigation sites (for other projects), and Wetland Reserve Program easements appropriate to compensate for losses from the proposed flood control project.

The Service's mitigation objectives for fisheries resources and habitat focus on avoiding impacts altogether or minimizing impacts through project modification. We believe those are critical steps in the mitigation planning process, particularly in the case of the regionally scarce fish and wildlife resources and functions of the lower New Madrid floodway. Because the project will permanently alter regional hydrology, it will be impossible, for the most part, to rectify adverse impacts to fish and wildlife by repairing, rehabilitating, or restoring the affected environment. The science of wetland and aquatic restoration is still quite limited in its ability to fully compensate for all functions of those ecosystems. In addition, given the unique nature of the New Madrid Floodway/Mississippi River connection, the potential to compensate project impacts by replacing or providing substitute resources or environments is even more limited.

The Service has enclosed an excerpt from our May 2000 Fish and Wildlife Coordination Act Report listing our specific mitigation recommendations for the previously analyzed alternatives. Please refer to that report for a more detailed discussion of those recommendations. Regardless of the amount and type of tracts needed to compensate project-related habitat losses, acquisition and reforestation of those lands, and shorebird management measures should be carried out concurrently with project construction, and should be in place prior to project operation. In addition, the Corps should include a specific commitment to that end in the Record of Decision for the project.

Service NEPA Participation

The Service provides the enclosed scoping comments and will review all HEP development/analyses, provide input on project-related consequences to fish and wildlife resources when possible (i.e., subject to staff availability), review and comment on draft sections of the revised SEIS prior to publication, and provide official comments on draft revised SEIS. The Service will also provide a draft and final Fish and Wildlife Coordination Report on the new alternatives to coincide with the preparation of the revised SEIS. Those reports will provide the Corps with additional resource information and recommendations for the revised SEIS.

The Service is committed to working with the Corps during the SEIS revision to develop an environmentally acceptable alternative that fulfills the project purpose of flood control. We believe the most effective way to do that is to avoid and minimize project-related losses of fish and wildlife resources to the maximum extent possible. Because of its connection with the river, the New Madrid Floodway provides regionally scare and significant aquatic habitat value for floodplain and riverine fish and wildlife. Unavoidable losses of such habitat value should be compensated in-kind (i.e., connected to the river) to conserve numerous federal trust resources, and maintain the remaining habitat base in a highly altered landscape.

Thank you for the opportunity to provide these early comments. Please contact Ms. Jane Ledwin of this office at (573) 876-1911, extension 109, if you have any questions or if we can be of further assistance.

Sincerely,

Charles M. Scott

Charles M. Scott
Field Supervisor

jlstjnwmdrdscpcmts3.wpd

Enclosures

cc: MDC, Jefferson City, MO (Christoff)
MDC, Cape Girardeau, MO (Boone)
DNR, Jefferson City, MO (Lange)
EPA, Region 7, Kansas City, KS (Cothern)
FWS, Region 3, Ft. Snelling, MN (Lewis)

Scoping Comments to be Addressed by the
Revised Draft Supplemental Environmental Impact Statement
for the
St. Johns Bayou and New Madrid Floodway Project
Submitted by the U.S. Fish and Wildlife Service

General

Clearly explain project purpose and need - For example, flood protection is understandable to the general public. "Eliminating the physical and economic impediments created by frequent flooding," is extremely confusing. The document should fully address the extent to which the existing project authority is met by each alternative.

Accurately reflect the Service's evaluations and recommendations throughout the document - Although unresolved issues and differences of opinion between the Service and the Corps are acknowledged in specific sections of the previous SEIS, there are a number of instances throughout the document that state findings clearly in conflict with the Services's assessments and recommendations. For example, the text contains factual errors regarding the limitations of the HEP models and the adequacy of the proposed mitigation plan. As a cooperating agency, the Service's evaluations and recommendations should be clearly reflected in each applicable section in the document. *In all instances where there is not a COE-Service consensus*, the text should note that a statement/finding is the opinion/determination of the Corps and not shared by the Service.

Evaluation of existing project alternatives (and any additional (new) alternatives)

Provide a more detailed description (for the lay person) of which areas receive what level of flood protection with each alternative - If innundation will be reduced, where will this happen, by how much, and when. We assume this information was used to determine what areas experience flood reductions sufficient to receive agricultural benefits. What areas in both basins will continue to flood after post-project, and when (e.g., East Prairie urban areas with deficient municipal drainage)?

Provide a more rigorous examination of an alternative that combines structural and non-structural measures - This should include incentives/assistance in developing floodplain-compatible "industries," such as reforestation or ecotourism, and site-specific structural measures to ensure public safety (e.g., highway upgrades, interior municipal drainage improvements, wetlands mitigation banking, etc.). In addition to potential economic benefits from hunting leases, timber income, tourism, carbon sequestration banking and nutrient reduction, such alternatives could greatly reduce the need for extensive compensatory mitigation, which may be substantial.

Provide a detailed explanation of economics considered for each alternative - The benefits and costs of each alternative should be clearly explained in lay terms. The discussion should include the economic consequences to agriculture and infrastructure from a given level of flood protection. The discussion should also include the limitations and assumptions used in the analyses as well as the effects of future fluctuations in agricultural prices on potential benefits of each alternative over the project life.

Provide a more rigorous examination of the costs of mitigation for each alternative - Some alternatives involve significant acres of compensatory mitigation. Assuming appropriate sites could be found within the basins, the SEIS should evaluate in detail how mitigation within the basins affects potential agricultural flood control benefits (i.e., withdrawing acreage from agriculture), and any effects on local and levee district revenues.

Provide a thorough analysis of the adequacy of potential mitigation sites - Each potential mitigation site should be evaluated with enough rigor to determine suitability of the site and potential compensatory mitigation credit. To do this, the document should provide pre- and post-project hydrologic and applicable HEP analyses. The discussion of mitigation lands should also include an assessment of the availability of lands through willing sellers, and how that could influence the number and quality of potential mitigation sites.

Additional Levee Alignments

Provide a detailed description of how each alternative affects floodway operation - This would most likely be applicable to structural alternatives (including those addressed in the previous SEIS). The analyses should detail the logistics and costs of floodway operation, including damages incurred to the floodway from those operations (e.g., existing and necessary future easements, structural repair/replacement of levees, roads, houses/sheds/mitigation features/etc.). Also consider how de-authorizing the floodway may affect logistics and costs associated with alternative levee alignments, particularly the northern-most alignments in the floodway.

Compare all alternatives against the no-action baseline - All action alternatives should be compared to the no-action (future without project) condition. Such an approach more accurately reflects the costs/benefits of each alternative and eliminates real or perceived bias for an alternative prior to a full evaluation. The evaluation for each alternative should document all costs and benefits, including environmental benefits associated with avoiding and minimizing losses of fish and wildlife resources and habitat. For example, greatly reducing the need for compensatory mitigation could significantly affect the cost of a given alternative.

Excerpt from Service's
May 2000
Fish and Wildlife Coordination Act Report
St. Johns Bayou and New Madrid Project

1.) Consider alternatives that specifically address East Prairie flooding problems, including ring levees, flood-proofing, and local drainage improvements. If additional flood control work is necessary, limit that work to the St. Johns Bayou basin. Work in the New Madrid Floodway will not provide flood relief to areas in and around East Prairie.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures.

a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. They may also function as grade control structures.

e.) Avoid dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

f.) Avoid dredging in a 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements, etc.) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the proposed alternatives, they should incorporate the following measures as integral features of the selected plan.

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns basin, and between 290 and 277 (Authorized Project) or 281 feet (A&M) NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures. (average annual acres)

1.) Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). Approximately 2,118 acres (Authorized Project) or 1,546 acres (A&M) would be needed to mitigate direct project impacts. If protective covenants have not been placed on BLH forest as described in 4(b), the Corps should reforest an additional 6,998 acres (Authorized Project) or 6,788 acres (A&M) to compensate for induced forested wetland losses because project-related reductions in flooding.

2.) Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

3.) Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below). Approximately 7,968 acres (Authorized Project) or 7,607 acres (A&M) of flooded agricultural lands would be necessary to mitigate those habitat losses.

4.) To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest an additional 2,343 acre (Authorized Project) or 1,950 acres (A&M) of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

5.) Provide shallow flooded (i.e., $\leq$ 18 inches) land in April and May to compensate for project-related losses in shorebird migration habitat. (Such areas could also partially compensate for losses to fisheries and waterfowl habitat.) Approximately 1,583 acres (Authorized Project) or 1,523 acres (A&M) of flooded cropland would be necessary to compensate shorebird habitat losses. Constructing moist soil areas to mitigate those losses would roughly halve the necessary acreage.

6.) Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with project construction and should be in place prior to project operation.

FILE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
608 East Cherry Street, Room 200
Columbia, Missouri 65201
Phone: (573) 876-1911 Fax: (573) 876-1914

July 12, 2001

Mr. David Reece, Chief
Environmental and Economic Analysis Branch
U.S. Army Corps of Engineers
B-202 Clifford Davis Federal Building
167 North Street
Memphis, Tennessee 38103-1894

Dear Mr. Reece:

Please refer to the June 12, 2001, interagency meeting as part of the continuing agency coordination for the revised draft Supplemental Environmental Impact Statement (SEIS) for the St. Johns Bayou and New Madrid Floodway Project, First Phase, located in Mississippi and New Madrid Counties, Missouri. At that meeting, the U.S. Fish and Wildlife Service (Service) provided the Corps of Engineers (Corps) with a copy of our formal scoping comments. As a result of the information presented at that meeting, the Service has additional issues that we believe should be addressed in the revised draft SEIS to better understand the alternatives under consideration and their effects to the environment. The Service submits the following comments pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

A large part of the June meeting was devoted to Corps staff briefing the agencies on floodway operations under potential project alternatives. It appears that such operations can be greatly influenced by the project alternative that eventually goes forward. In addition, at that meeting the agencies were told that the Corps anticipates operating the floodway every 25 years on average. Therefore, it is important to understand how the project alternatives under consideration and New Madrid Floodway operations could affect one another.

The revised draft SEIS should thoroughly explain floodway operations for each alternative under consideration. That should include a detailed evaluation of the costs and logistics of floodway operations, and the environmental and economic effects of those operations on floodway infrastructure, agriculture, natural resources, and potential mitigation sites. That discussion also should include the expected periodicity of floodway operations, as well as the cost of repairing any damages resulting from those operations.

In the previous SEIS, the Corps examined effects of the New Madrid levee closure on Mississippi River stages along the adjacent river reach during a Project Design Flood (i.e., when the floodway would be operated). We believe it would also be helpful to understand the effects of the project alternatives on river stages during less frequent events (i.e., 5, 10, 25, and 50-year) as well. Such information could be particularly important in evaluating potential mitigation sites in the project area.

It is evident that floodway operation will be a significant factor considered by the Corps in selecting the preferred alternative. Consequently, all aspects of floodway operations can have a profound effect in how the conservation of important fish and wildlife resources is balanced with flood protection to produce a feasible, environmentally sound project. Therefore, the Service considers this to be a critical issue for consideration under our respective responsibilities in the Fish and Wildlife Coordination Act and National Environmental Policy Act that warrants detailed evaluation in the revised SEIS.

Thank you for your consideration of our comments. Please contact Ms. Jane Ledwin (573/876-1911, extension 109) if you have any questions on our comments.

Sincerely,

Kelley Srigley Werner

for Charles M. Scott
Field Supervisor

cc: MDC, Jefferson City, MO (Christoff)
MDC, Cape Girardeau, MO (Boone)
EPA, Kansas City, KS (Cothern)
ES Supervisor, Area 2, Ft. Snelling, MN

BCC: FWS, DHC, ARLINGTON, VA (MATUSIAK)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
608 East Cherry Street, Room 200
Columbia, Missouri 65201
Phone: (573) 876-1911 Fax: (573) 876-1914

October 16, 2001

Colonel Jack V. Sherer, District Engineer
U.S. Army Corps of Engineers
B-202 Clifford Davis Federal Building
167 North Street
Memphis, Tennessee 38103-1894

FILE

Dear Colonel Sherer:

The U.S. Fish and Wildlife Service (Service) submits this Fish and Wildlife Coordination Act letter-report to aid the Memphis District Corps of Engineers (Corps) in revising the Supplemental Environmental Impact Statement (SEIS) for the St. Johns Bayou and New Madrid Floodway Project, First Phase, located in Mississippi and New Madrid Counties, Missouri. The Service submits this letter pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.). This letter-report does not constitute the report of the Secretary of the Interior as required by Section 2(b) of the Act. This letter-report has been coordinated with the Missouri Department of Conservation.

Introduction

The St. Johns Bayou and New Madrid Floodway Project was authorized for construction by the Water Resources Development Act of 1986. The original project included 130 miles of channel widening and clearing, construction of a 1,000 cubic-feet-per-second pump station at the outlet of St. Johns Bayou, construction of a 1,500 cfs pump station at the outlet of East Bayou (Mud) Ditch on the Floodway, and several mitigation features. The project also included closure of a 1,500-foot gap in the Mississippi River Frontline Levee at the lower end of the New Madrid Floodway authorized by the 1954 Flood Control Act. A Feasibility Report and Environmental Impact Statement for the original project were filed in 1976 and a Supplemental EIS was completed in 1982. The Corps completed the Phase II General Design Memorandum in 1986, and it serves as the basis for the current re-analysis. The original project was never constructed because the local sponsor(s) could not meet cost-share requirements.

In 1996, Congress appropriated funds for the Corps to reformulate the original project. At the same time, the U.S. Department of Agriculture (USDA) designated the community of East Prairie, Missouri, which lies within the St. Johns Bayou basin, an Enterprise Community. In addition, the 1996 Water Resources Development Act exempted the East Prairie Phase from normal cost-sharing requirements, allowing USDA funds allotted to the community of East Prairie to be used to fulfill non-federal cost share requirements for a reformulated East Prairie

Phase of the project. In April 1999, the Corps, with the Service as a cooperating agency, released a draft SEIS. The Service's draft Fish and Wildlife Coordination Act Report (CAR) was attached to that document. The Service noted its concern regarding significant losses of nationally significant fish and wildlife resources, and included a number of recommendations and alternatives to reduce those impacts and compensate for unavoidable losses while meeting project purposes. In September 2000, the Corps issued a final SEIS on the project. While that document included more detailed discussions of several project impacts, the preferred alternative remained essentially unchanged from the draft. Therefore, in the final CAR (June 2000) (incorporated herein by reference), the Service reiterated its recommendations to reduce project impacts to fish and wildlife, and its opposition to the preferred alternative (USFWS 2000). Both the Department of the Interior and the Environmental Protection Agency notified the Corps of their intention to refer the project to the President's Council on Environmental Quality (CEQ), should the Corps proceed with the preferred alternative.

To avoid a full CEQ referral and attempt to resolve outstanding resource issues associated with the preferred alternative, the Department of the Army, Department of the Interior, and Environmental Protection Agency formed a headquarters-level team to formulate a number of options to the preferred alternative. That team developed several alternative levee closure alignments to be analyzed in a revised SEIS. In addition, the Service provided to the Corps a June 7, 2001, scoping letter identifying numerous environmental and economic issues that should be addressed in the revised document. We also provided a July 12, 2001, letter noting several aspects of floodway operations that should be covered for each alternative to understand and compare the effects of those alternatives.

This letter-report addresses the additional levee alignments and potential pumping modifications to be included in the revised SEIS. This report reflects the data limitations associated the Corps accelerated schedule to complete the revised SEIS. Therefore, we were unable to included analyses of pumping modifications which could reduce impacts to fish and wildlife resources. The Service will prepare a final CAR to accompany the final SEIS that includes our recommendations and analyses of those modifications.

Project Area

The St. Johns Bayou basin and the New Madrid Floodway are part of the historic Mississippi River floodplain. Although highly altered, the project area still functions as an integral part of the Mississippi River ecosystem, providing important breeding, migration, and overwintering habitat for numerous species of neotropical migratory songbirds, and migratory waterfowl, waterbirds and shorebirds. The New Madrid Floodway is unique in Missouri because it is the only significant portion of the historic Mississippi River floodplain still largely connected to the river. That connection provides valuable hydrologic exchange between the Mississippi River system and the adjacent terrestrial ecosystem and supports some of the most diverse and productive wetland habitats remaining in southeast Missouri. Three federally listed and 58 State-listed species occur in the project area. Recent sampling documents the project area supports a fishery comprised of 114 species, which represents 42 percent of the fish species known from Missouri, including one believed to have been extirpated from the state. The project area also provides significant habitat for diverse and abundant freshwater mussel communities comprised of 24 species; over one-third of those known to occur in Missouri. Of the original 2.5 million acres of forested wetlands that once covered southeast Missouri, only about 50,000 acres (2 percent) remain and serve as critical refugia for dozens of fish and wildlife species that once flourished throughout the Mississippi River floodplain. The forested wetlands in the project area, a small remnant of a once extensive floodplain complex are becoming increasingly scarce. In spite of extensive modification, the diverse wetland habitats within the project area support nationally significant fish and wildlife resources that enhance biodiversity state-wide and regionally, and helps preserve the ecological integrity of the lower Mississippi River. (Please refer to USFWS 2000 for a complete description of project-area fish and wildlife resources.)

Project Description

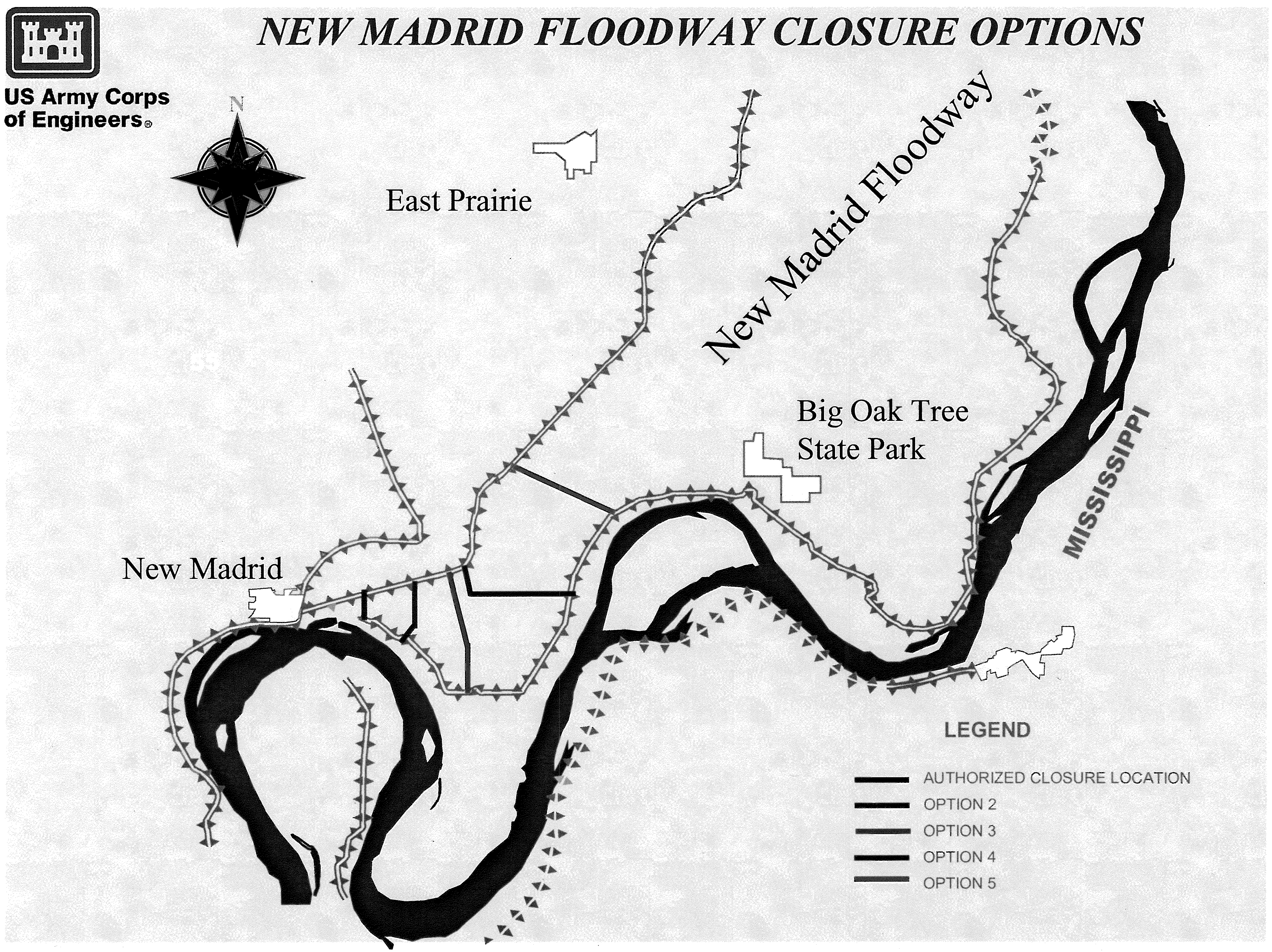
The purpose of the East Prairie Phase of the St. Johns Bayou and New Madrid Floodway Project is flood control and associated economic and infrastructure development in the project area. It includes 23.4 miles of channel work within the St. Johns Bayou basin, the St. Johns Bayou pump station, the New Madrid Floodway pump station, and a separately authorized closure of the gap in the frontline levee. The St. Johns basin features of the project will provide a 25-year level of flood protection to the immediate area in and around East Prairie. Although the original project was designed to provide a 1.1-year level of flood protection to the New Madrid Floodway, recent discussions with Corps staff indicate they have not designated a flood protection-level, but note that the project will reduce the duration of flooding in areas that currently experience backwater flooding from the Mississippi River.

Table 1. Summary of Levee Closure Alignments

Option	Length	Engineering	Floodway Operations
1 (Previous Preferred Alt.)	0.28 miles	No Change	No Change
2 (2.2 miles up floodway)	1.23 miles	No Change	Additional Real Estate*
3 (3.4 miles up floodway)	3.5 miles	Reevaluation/Design	Additional Real Estate/ Operation Authority*
4 (3.9 miles up floodway)	3.0 miles	Reevaluation/Design	Additional Real Estate/ Operation Authority*
5 (7.5 miles up floodway)	2.84 miles	Reevaluation/Design	Additional Real Estate/ Operation Authority*

* These options require either additional crevasse and damage easements and/or additional authority to operate

NEW MADRID FLOODWAY CLOSURE OPTIONS



The previous Authorized and Preferred alternatives, are described in detail in the Final SEIS (USACE 2000). The Corps has identified four additional alternative levee closures to be considered (Figure 1 and Table 1). The location of these levee closure alternatives generally are the same as options developed by the interagency headquarters team. The Corps has not identified a preferred alternative at this time.

In addition to the levee alignments, the Corps is also evaluating seasonal modifications to pumping operations to reduce impacts to fish and wildlife (Table 2). Those modifications would delay gate closures and pumping operations to allow greater fisheries access to the basin and provide more suitable fisheries habitat during the spawning and nursery seasons.

Table 2. Pumping Operations

Option	**Spring pump operations**
A- Avoid and Minimize (included in previous SEIS alternatives)	start elevation 282.5' NGVD stop elevation 280.0' NGVD
B- Modified operations (annually until May 15)	start elevation 284.4' NGVD stop elevation 283.4' NGVD
C - Modified operations (annually until May 15) (every 3rd year)	start elevation 284.4' NGVD stop elevation 283.4' NVGD start elevation 288.0' NGVD stop elevation 287.0'NGVD

Project Impacts

Methods

The Corps evaluated environmental impacts on all lands 300' NGVD and below, the area subjected to backwater flooding by the Mississippi River. Still unknown are the nature and extent of indirect impacts to habitats above 300' NGVD due to project-related changes in flooding duration and periodicity with improved drainage in the project area. Because of the Corp's accelerated schedule for this reevaluation, the results in this letter-report should be considered preliminary. The Service has not reviewed the data beyond a cursory, qualitative analysis. Unless otherwise noted (i.e., fisheries analysis), the impacts reported do not include effects from modified pump operations described in Table 2.

To evaluate project-related changes to fish and wildlife resources, the Corps used the same Habitat Evaluation Procedures (HEP) species models as were used for the previous SEIS (USACE 2000) which are detailed in the Service's report (USFWS 2000). In the current reevaluation, the alternatives for the with-project alternatives, consider only direct impacts to wildlife habitat. They do not reflect the significant indirect impacts to forested habitats resulting from project implementation as agreed to by the original HEP team. The Service believes that is a significant error in the impacts analysis, and will provide the Corps with our quantitative evaluation as soon as possible.

Wetlands

Impacts of the Authorized and previous Preferred alternatives on fish and wildlife resources are detailed in the final SEIS (USACE 2000) and the Service's CAR (USFWS 2000). Wetland results given in this report for those alternatives differ from the previous analyses because the Corps has revised their wetland classification system. Previously, for planning purposes, the Corps classified all lands inundated greater than 12 days as functional wetlands, which included a large number of cropped areas. In this reevlauation, the Corps revisited that classification scheme. They have further defined wetlands as those that meet the jurisdictional criteria of 12 days of inundation under Section 404 of the Clean Water Act, and 15 days of inundation for farmed wetlands under the Food Security Act (FSA)(Table 3). The Corps delineated wetlands and evaluated effects based on inundation from backwater flooding. It is unclear from the information provided the nature and extent of wetlands inundated by a combination of headwater and backwater flooding, ponding, and saturation, or the effects of the alternatives on those wetlands.

Based on the Corps analyses, all alternatives but Option 5 would affect more the 75 percent of wetlands delineated below 300' (Tables 3 and 4). Both Options 1 and 2 reduce inundation on almost all delineated wetlands. Options 1 through 4 would lead to significant losses of both farmed and non-farmed wetlands. Under all project alternatives, spring water levels will be significantly lower than existing conditions. The Corps believes that there will be no indirect project-related changes in jurisdictional non-cropped wetlands (e.g., forested wetlands) because they anticipate that rainfall and groundwater seepage will maintain saturated soils in the existing wetlands sufficient to meet the wetland criteria. The Service, however, does not share this opinion, and has detailed our rationale in our report (USFWS 2000), which is hereby incorporated by reference. In many cases, modifications to the project area's natural hydrology and land owner practices have a greater effect on the distribution of wetlands than does the presence of hydric soils. Although the Mississippi River seasonally recharges the groundwater in the eastern portions of the project area, the interaction between surface water, groundwater and river seepage is poorly understood (U.S.G.S., per. comm.). Currently, the Corps is working on several seepage control features in the Floodway as part of the Mississippi River Mainline Levee enlargement that will further modify water patterns in the project area. In addition, the cropping patterns in areas previously subject to backwater flooding are likely to emphasize more profitable crops and increase the use of irrigation, increasing surface and groundwater demands. A study

Table 3. New Madrid Floodway Wetland Acreage Impacts*

Land Use	Wetland Acres <300'	Option 1 Acres affected	Option 1 Percent of wetlands <300'	Option 2 Acres affected	Option 2 Percent of wetlands <300'	Option Acres affected
Forested	3,854	3,569	93%	3,492	91%	2,776
Scrub/shrub marsh	82	80	98%	80	98%	80
Cropland	6,187	6,125	99%	6,015	97%	5,835
Pasture	102	95	93%	84	83%	68
Herbaceous	840	807	96%	794	94%	744
Open Water	595	525	88%	517	87%	506
Sandbar	0	0	0%	0	0%	0
Urban	0	0	0%	0	0%	0
Total	11,660	11,201	96%	10,982	94%	10,009

* includes both direct and indirect effects
to jurisdictional wetlands assuming the 285.2 start elevation for the pumps.

Table 4. Wetlands with reduced inundation*

Land Use	ExistingConditions	Option 1	Option 2	Option 3
Agriculture (farmed wetlands) (based on 15-day inundation)	6186	6121	6010	5832
Non-ag. Wetlands (based on 12-day inundation)	5472	5066	4949	4152

assuming the 285.2 start elevation for the pumps.

by Luckey (1985) in southeast Missouri found that enhanced drainage lowers groundwater levels in the soil. Maki et al. (1980) further noted that channelization not only reduces the amount of ponding on floodplains, but shortens ponding duration during the growing season because evapotranspiration demands can effectively eliminate surface ponding. This affects not only jurisdictional status, but habitat value a well, particularly for those species (e.g., reptiles and amphibians) that require ephemeral wetlands to complete their lifecycles. In addition to changes in the extent of wetland hydrology, project implementation will replace a naturally variable flooding regime with a well-regulated, fairly predictable flooding pattern. That greatly lowers the level of risk to farmers who chose to crop previously marginal areas. Considering the changes in future surface-water levels throughout the project area, reasonably foreseeable modifications to the project area's drainage patterns, and existing land practices, the Service believes most of the privately-owned forested wetlands no longer subject to backwater flooding will face greater development pressure and likely will be converted to agriculture use.

Although Option 4 would lead to relatively fewer impacts to wetlands, it would still result in the loss of over 6,000 acres of farmed wetlands. Such government-sponsored, large-scale conversion of wetlands to non-jurisdictional croplands dwarfs wetlands losses through permitted activities in the region, and may have significant implications under the FSA . Without sufficient mitigation, such conversion would possibly violate the "Swampbuster" provisions of the FSA, which in turn could affect project sponsors who participate in federal agricultural programs.

Wildlife

Project impacts from the previous Preferred alternative are analyzed in detail in the Service's CAR (USFWS 2000). Option 1 would reduce seasonal flooding on over 23,000 acres of wetlands and frequently flooded lands in the lower Floodway. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area, and the Service believes many of those would be converted to agriculture once seasonal flooding is removed. As already noted, results from the Corps analyses (Table 5) do not include development of forested tracts that will no longer qualify as jurisdictionally wet because of project-related drainage, which we believe will be substantial. Based on the Service's previous HEP analyses for Option 1, project-related indirect losses of forested habitat would be almost 100 times greater than direct losses from levee construction. Therefore, we believe the results in Table 5 grossly underestimate impacts to wildlife from the various alternatives.

It is clear that only Option 5 reduces wildlife impacts to any great extent. That is true for both forested habitats and cropped shorebird habitats. It should be noted that the results of the shorebird analyses are greatly influenced by assumptions on cropping patterns. Much of shorebird habitat value under the alternatives is provided by predicted increases in acres of rice within the project area, as agreed to by the original HEP team. The effects of each alternative could be quite different under other cropping scenarios.

Table 5. Impacts to Forested Wetlands and Marsh/Scrub-Shrub habitat and associated wildlife (in average annual habitat units)

Evaluation Species	Option 1	Option 2	Option 3	Option 4	Option 5
Barred Owl	-15.22	-10.69	-11.34	-11.77	-1.94
Fox Squirrel	-11.49	-8.28	-8.78	-9.11	-1.51
Pileated Woodpecker	-12.56	-8.64	-9.16	-9.51	-1.57
Carolina Chickadee	-15.43	-10.79	-11.44	-11.88	-1.96
Mink	-11.28	-2.6	-2.76	-1.63	0
Total Forested	**-65.98**	**-41**	**-43.48**	**-43.9**	**-6.98**
Red-winged Blackbird	0	0	0	0	0
Great Blue Heron	0	0	0	0	0
Muskrat	4.06	4.06	3.92	4.06	4.06
Total Marsh/Scrub/Shrub	**4.06**	**4.06**	**3.92**	**4.06**	**4.06**
Shorebirds	**-656.78**	**-647.04**	**-605.53**	**-478.68**	**-284.56**

Implementation of the proposed project alternatives would greatly alter the habitat available for wintering and migrating waterfowl. One negative impact will be the loss of flooding diversity. Flood timing, duration, and depth will be controlled through pump operations, removing natural variability which contributes to the overall health and stability of wetland ecosystems. The Service has not completed its analysis of the effects of the new alternatives on waterfowl resources. However, impacts from most of those alternatives should be less than, but similar to, the previous preferred alternative. The previously analyzed alternatives would potentially produce an increase in duck-use days (DUDs) in December and January, while reducing DUDs in February and March, primarily because of increased moist soil and soybean acreage. Under those alternatives, moist soil and forest acreage flooded during spring migration would be significantly lower, reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988). Based on the negative impacts of prolonged ponding on forested habitats (USFWS 2000), we strongly recommended that the operational plan allow for the greatest possible diversity of flood timing, duration, and depth November through March. We believe such a plan would realize more benefits to waterfowl, as well as other species. Altering the operational plan would also allow the river to ebb and flow into both basins during that time, greatly benefitting fisheries resources by maintaining connectivity between the river and its floodplain. Based on the Final SEIS, however, it is unclear how the Corps intends to operate winter sump areas for waterfowl.

It is important to note that waterfowl model does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, pers. comm.). Furthermore, the model does not consider other forested wetland habitat components necessary for healthy waterfowl populations. During spring migration, waterfowl are forming pairs, molting, and preparing to breed (Heitmeyer 1985). Forested wetlands fulfill special seasonal waterfowl habitat requirements not found in open land (i.e., moist soil areas and farmed wetlands). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. All proposed project alternatives would eliminate backwater flooding on thousands of acres of forested wetlands and moist soil areas during spring migration, significantly reducing habitat that provides necessary protein sources particularly important to waterfowl at that time of year. Under existing conditions, those waterfowl acres occur during spring flooding and are distributed over up to 75,000 acres. Large flooded areas such as those are critical for waterfowl, especially as they form breeding pairs. Because of the differing seasonal habitat requirements of waterfowl, potential fall migration and winter habitat benefits cannot replace significant spring migration habitat losses.

Fisheries

Project-related changes in flooding patterns will greatly decrease fish spawning and rearing habitat values in the New Madrid Floodway. In addition, closing the levee to prevent spring flooding from the Mississippi River will virtually eliminate riverine fish access to thousands of acres of spawning and nursery habitat in the Floodway during the critical spawning season. It should be noted, however, that the fish HEP evaluated habitat value as a function of cover type and inundation. It did not consider the effects of gate operations on fish access to the floodway. Therefore, the results are likely conservative estimates of fisheries impacts.

Based on the information we have to date (Table 6) only Option 5 significantly reduces impacts that can be modeled and would leave far more acres available to fisheries. We do not have information on impacts to early and late season spawning and rearing habitat, nor impacts by habitat type. Although each alternative provides some suitable habitat inside the levee, many fishes avoid swimming through structures, and thus the fisheries access may be extremely reduced even when the gates are open. It appears that pump modifications could reduce impacts to fisheries, particularly in combination with a vigorous, directed mitigation plan that would reforest areas below the levee closure and within the sump (i.e., those areas flooded at 288'). Such efforts should be evaluated in greater detail to determine the potential habitat benefits to the fisheries.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

# of pages ▶ 9	
To D. Reece	From J. Ledin
Dept./Agency MVM/Planning	Phone # USFWS
Fax #	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

Table 6. Mid-season floodplain acres, Annualized Habitat Units (HU) lost, and mitigation requirements for each option in the New Madrid Floodway for fishes rearing habitat.

Option	Post-Project Acres	Acres Lost [1]	HU Lost[2]	Reforested Acres[3]
Authorized	109.7	5503.3	2924.1	8860.9
1 - 282.5	349.6	5263.4	2720.4	8243.6
1 - 284.4	1036.3	4576.7	2329.4	7058.7
1 - 288.0[4]/282.5	1433.6	4179.4	2111.7	6399.1
1 - 288.0[4]/284.4	1891.4	3721.0	1851.1	5609.3
2 - 282.5	492.4	5120.6	2649.4	8028.5
2 - 284.4	1179.1	4433.9	2258.4	6843.6
2 - 288.0[4]/282.5	1576.0	4036.6	2040.3	6182.7
2 - 288.0[4]/284.4	2034.2	3578.2	1780.1	5394.2
3 - 282.5	870.1	4742.9	2432.5	7371.2
3 - 284.4	1556.8	4056.2	2041.5	6186.4
3 - 288.0[4]/282.5	1954.1	3658.9	1823.8	5526.7
3 - 288.0[4]/284.4	2411.9	3201.1	1563.2	4737.0
4 - 282.5	1538.3	4074.7	2104.3	6376.7
5 - 282.5	3216.8	2396.2	1343.8	4072.1

[1] Relative to existing acres of 5,613.0
[2] Relative to existing HUs of 2,998.6
[3] Based on enhancement value of 0.33
[4] Occurs once every three years: Acres lost=2,010.8, HU lost=894.9

Endangered Species

Three federally listed species occur in the project area; the bald eagle, the pallid sturgeon, and the interior least tern. Project implementation will significantly reduce backwater flooding in the project area during spring, particularly in the New Madrid Floodway. That, in turn, will virtually eliminate seasonal use of the floodplain by Mississippi River fishes. Bald eagles have recently constructed nests in the lower Floodway in an area that will no longer be subjected to spring flooding under some alternatives. In addition, several least tern colonies occur adjacent to and downstream of the project area. Because of the importance of fish in the diets of both species, significant project-related impacts to fisheries production may also affect those species. The

Service prepared a June 1999 biological opinion on project effects to the bald eagle and the least tern. In that biological opinion, the Service determined that the project is not likely to jeopardize the bald eagle and the interior least tern, and included reasonable and prudent measures to minimize incidental take of those species. The Service has concurred with the Corps that the project is not likely to adversely affect the pallid sturgeon, which occurs in the Mississippi River, based on insignificant effects (i.e., effects that can not be meaningfully measured or detected.). At this time, the Corps has not identified a preferred alternative on which to consult. We believe there are alternatives that could potentially have fewer to no adverse effects to federally listed species. In the latter case, formal section 7 consultation would not be necessary.

Fish and Wildlife Conservation Measures

Based on the information currently available, Options 1 through 4 will eliminate most of the overbank flooding that periodically inundate thousands of acres in the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A wide variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals use those habitats during all or part of their life cycle. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by most project alternatives. Those project alternatives will greatly decrease fish spawning and rearing habitat values in the New Madrid Floodway. In addition, closing the levee to prevent natural spring flooding from the Mississippi River will virtually eliminate fish access to the Floodway during the critical spawning season. Closing the gap in the New Madrid Floodway will severe the link between the Mississippi River and its only connected tributary-floodplain complex in Missouri. The riverine ecosystem will lose the productivity that is released by the floodplain during high water. Under most of the proposed alternatives, river fishes, especially early spawners such as white bass, will lose most of the extensive spawning, rearing, and foraging habitat provided by the Floodway. Because of the significant project-related impacts to fish and wildlife resources, the Service believes that project plans can and should be further modified to adequately mitigate those significant fish an wildlife resources.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

> (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the actions; and (e) compensation for the impact by replacing or providing substitute resources or environments.

The Service also adapted these sequential steps for mitigation in its Mitigation Policy as did EPA in its Clean Water Act Section 404(b)(1) Guidelines. The Service's mitigation objectives for wildlife and fisheries resources focus on avoiding impacts altogether or minimizing impacts through project modification as detailed in USFWS (2000). We believe avoidance and minimization are critical steps for this project, particularly in the case of the regionally scarce fish and wildlife resources and ecologic functions of the lower New Madrid Floodway. Because the project will permanently alter regional hydrology, it will not be feasible to rectify or compensate for fish and wildlife losses by repairing, rehabilitating, or restoring the affected environment. The science of wetland and aquatic restoration is still quite limited in its ability to fully compensate for all functions of those ecosystems. In addition, given the unique nature of the New Madrid Floodway/Mississippi River connection, the potential to compensate project impacts by replacing or providing substitute resources or environments is even more limited than science. The National Academy of Sciences (NAS in press) notes that because of the difficulties in restoring rare or unique wetland systems, they recommend avoiding such losses. Therefore, we continue to recommend avoidance of wetland impacts, to the maximum extent possible, as the most effective measure to conserve the extent and diversity of wetland functions in the New Madrid Floodway.

The Service has previously recommended a number of structural and non-structural alternatives that we believe would better address the local needs while reducing impacts to fish and wildlife (USFWS 2000). Those recommendations focus on specific structural measures to address infrastructure needs, while looking to non-structural measures as an environmentally acceptable, economical, and sustainable means to reduce flood damages in the project area. Among the non-structural recommendations were efforts to diversify the local economy with activities compatible with the Mississippi River floodplain (i.e., reforestation for timber production, easement on existing forests, hunting leases, ecotourism). Natural resources contribute to Missouri's economy in many ways through both consumptive and non-consumptive use. The project area is part of the "River Heritage Region" of Missouri. The region boasts of its natural beauty and outdoor recreational opportunities, from birdwatching to traditional consumptive uses (hunting and fishing) and entices tourists to visit the Big Oak Tree State Park - "one of the last remaining virgin bottomland forest and cypress swamps in the nation." New Madrid County also promotes ecotourism particularly to the Donaldson Point Conservation Area and the Mississippi River. Clearly, the "River Heritage Region" of Missouri is proud of its natural resources and promotes both consumptive and non-consumptive uses of those resources. We believe there is great opportunity in further developing such important and sustainable resources and associated activities.

The Missouri Tourism Board and the Missouri Department of Economic Development (MDED) have documented economic benefit of natural resources to the state. In 1999, tourism $12 billion in economic benefits to the state (MDED 2000). In 1999, tourism provided $159 million to the economy of the Bootheel Region of Missouri, and provided 2,673 jobs with wages or salaries totaling over $46 million. State tax revenues for tourism in the Bootheel were over $6 million (MDED 2000). Wildlife watching provided Missouri $16.7 million in state sales tax revenue and

$8.0 million in state income tax revenue (USFWS 1996). Recreational fishing and hunting expenditures in the state of Missouri is in the billions of dollars (Weithman 1991). The MDED (2001) reported on the positive impact of natural amenities on population and employment in Missouri. The study found that above average natural amenities and a diversified economy are the major determinants of population growth and moderate determinants of employment growth. The study concludes with " In Missouri, it is increasingly important to include natural amenities as a factor in any economic development strategy."

Only after the Corps has avoided/minimized losses of important fish and wildlife resources to the maximum extent, should replacement or compensation of unavoidable losses be considered. Because of its connection with the river, the New Madrid Floodway provides significant and regionally scarce aquatic habitat value for floodplain and riverine fish and wildlife. Consequently, unavoidable losses of such habitat value should be replaced in-kind (i.e., connected to the river) to conserve numerous federal trust resources, and maintain the remaining habitat base in a highly altered landscape. In our CAR (USFWS 2000), the Service detailed specific criteria for mitigation lands to adequately compensate unavoidable habitat losses. Consistent with Service policy, lands already dedicated to fish and wildlife resources (i.e., Wetlands Reserve Program easements; Partners for Fish and Wildlife lands; lands to compensate resource losses from previous federal projects or permits; local, state, or federal wildlife conservation lands) would not be appropriate for compensatory mitigation. In addition, our recommendations are designed to maintain both the habitat diversity and hydrologic equivalency of lands affected by the project. The importance of hydrologic equivalence in replacing ecologic functions is underscored by the NAS (in press), and other big river ecologic research (Galat and Lipkin 1999, Galat et al. 1998, Poff et al. 1997, Richter et al. 1998). For example, batture lands have been suggested as potential mitigation lands for this project. Aside from the fact that enhancement measures would provide little additional fish and wildlife benefit above existing conditions, both the hydrologic and temperature regimes of those areas differ significantly from those of the Floodway. Recent research (Schramm et al. 2000) suggests that such temperature differences may greatly influence the reproductive and recruitment success of riverine fishes, particularly those species that use the floodplain as spawning and nursery habitat. In addition, the hydrology found on much of the batture lands would likely make adequate reforestation, the proposed mitigation method, highly questionable. Therefore, the Service continues to object to the use of batture lands as compensatory mitigation for project-related impacts in the Floodway.

Another critical component of an adequate compensatory mitigation plan, is an effective legal mechanism to assure acquisition, implementation, and long-term sustainability of habitat creation/restoration efforts (NAS in press). Without such a mechanism, the timing, appropriateness, and success of compensatory mitigation efforts is highly speculative, particularly for large-scale, highly complex projects. That is further confounded in project areas where the goal of the project is to intensify agriculture through increased drainage. In the New Madrid Floodway, it is unlikely that land owners will offer for sale appropriate mitigation lands once those lands received greater flood protection and become less marginal for crop production. Keeping lands within the proposed sump areas in agriculture could also eventually undermine

3. Because of the constraints of assuring acquisition of appropriate compensatory mitigation lands solely from willing sellers, the Corps should seek authorization necessary to ensure the timely and appropriate acquisition and reforestation of compensatory mitigation lands as an integral part of the project.

The Service is committed to working with the Corps to develop an environmentally acceptable alternative that fulfills the project purpose of flood control, while minimizing impacts to fish and wildlife. We believe the most effective way to do that is to avoid and minimize project-related losses of fish and wildlife resources to the maximum extent possible. We also believe there are alternatives that may, pending further evaluation, result in reduced impacts to fish and wildlife that could be compensible. Therefore, we recommend that the Corps, if they choose to implement a structural approach to flood control, vigorously pursue further analysis of those alternatives.

If the Corps selects either of the lower two levee alignments as the preferred alternative, we strongly recommend that the Corps sponsor a thorough independent review of both the environmental and economic effects of the project. That review should include a rigorous scientific assessment of impacts to fish and wildlife resources, as well as the adequacy of the proposed mitigation plan. In addition, that review should carefully examine the economic costs and benefits of the project, including the underlying assumptions of flood control and agricultural benefits, as well as economic benefits associated with fish and wildlife resources.

Please contact Ms. Jane Ledwin of this office at (573) 876-1911, extension 109, if you have any questions or if we can be of further assistance.

Sincerely,

Rick L. Hansen

for Charles M. Scott
Field Supervisor

cc: MDC, Jefferson City, MO (Christoff)
DNR, Jefferson City, MO (Lange)
EPA, Region 7, Kansas City, KS (Cothern)
FWS, Region 3, Ft. Snelling, MN (Lewis)

Literature Cited

Fredrickson and Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323. *In*, M.W. Weller (ed.), Waterfowl in Winter - a symposium. Univ. Minnesota Press, Minneapolis, MN.

Galat, D.L. and R. Lipkin. 1999. Characterizing the Natural Flow Regime of the Missouri River Using Historical Variability in Hydrology. Final Report to the Missouri Department of Conservation. Fish and Wildlife Research Center, Columbia, Missouri. 67 pages.

Galat, D.L., L.H. Fredrickson, D.D. Humburg, K.J. Bataille, J.R. Bodie,J.D. Dohrenwend, G.T. Gelwicks, J.E. Havel, D.L. Helmers, J.B. Hooker, J.R. Jones, M.F. Knowlton, J. Kubisiak, J. Mazourek, A.C. McColpin, R.B. Renken and R.D. Semlitch. 1998. Flooding to restore connectivity of regulated, large-river wetlands. *BioScience Vol. 48 No. 9: 721-733.*

Heitmeyer, M.E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the upper Mississippi Delta. Ph.D. Thesis, Univ. Missouri, Columbia. 376 pp.

Luckey, R.R. 1985. Water resources of the southeast lowlands, Missouri. Water Investigations Report 84-4277. U.S. Geological Survey, Rolla, Missouri. 78 pp.

Maki, T.E., A.J. Weber, D.W. Hazel, S.C. Hunter, B.T. Hyberg, D.M. Flinchum, J.P. Lollis, J.B. Rognstad and J.D. Gregory. 1980. Effects of stream channelization on bottomland and swamp forest ecosystems. Water Resources Research Institute, University of North Carolina, Raleigh, North Carolina. 135 pp.

Missouri Department of Economic Development, Research and Planning. 2001. Understanding Natural Amenities: Impacts on Population and Employment in Missouri. Found at http://www.ded.state.mo.us/research on July 5, 2001.

Missouri Department of Economic Development, Research and Planning. 2000. The Economic Impacts of Tourism in Missouri. Found at http://www.ded.state.mo.us/research on July 5, 2001.

NAS. In press. Compensating for Wetland Losses Under the Clean Water Act. Committee on Mitigating Wetland Losses, Board on Environmental Studies and Toxicology, Water Science and Technology Board, National Research Council 320 pages (approximate).

Poff, N.L., J.D. Allen, M.B. Bain, J/R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks and J.C. Stromberg. 1997. The natural flow regime. *BioScience Vol. 47 No. 11:769-784.*

Richter, B.D., J.W. Baumgertner, D.P. Braun and J. Powell. 1998. Assessing hydrological connectivity within river ecosystems. Regulated Rivers: Research and Management, 14:329-340.

Schramm, H. L., M.A. Eggleton and R.M. Mayo. 2000 Habitat conservation and creation: invoking the flood-pulse concept to enhance fisheries in the lower Mississippi River. Polsie Archiwum Hydrobiologii No. 47, Vol. 1, pages 45-62.

USACE. 2000. Flood Control, Mississippi River and Tributaries, St. Johns Bayou and New Madrid Floodway, MO, First Phase. Supplemental Environmental Impact Statement. U.S. Army Corps of Engineers, Memphis District, Memphis, Tennessee. 131 pages + appendices.

USFWS. 2000. St. Johns Bayou and New Madrid Floodway Project, East Prairie Phase, Fish and Wildlife Coordination Act Report. U.S. Fish and Wildlife Service, Columbia, Missouri. 58 pages + appendices.

USFWS. 1996. 1996 National and State Economic Impacts of Wildlife Watching, Based on the 1996 National Survey of Fishing, Hunting and Wildlife Associated Recreation. U.S. Fish and Wildlife Service, Division of Economics. Arlington, Virginia. 114 pages + appendices.

Weithman, A.S. 1991. Recreational Use and Economic Value of Missouri Fisheries. Missouri Department of Conservation, Dingell-Johnson Project F-1-R-40, Study SI-1.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Columbia Ecological Services Field Office
608 East Cherry Street, Room 200
Columbia, Missouri 65201
Phone: (573) 876-1911 Fax: (573) 876-1914

June 6, 2002

Colonel Jack V. Scherer, District Engineer
U.S. Army Corps of Engineers
167 North Main Street, B-202
Memphis, Tennessee 38103-1894

Dear Colonel Scherer:

This is the U.S. Fish and Wildlife Service's (Service) Supplemental Fish and Wildlife Coordination Act (FWCA) Report for the St. Johns Bayou and New Madrid Floodway Project, Missouri. This report supplements and updates the Service's last FWCA Report (June 7, 2000) for this project. Our report contains the recommendations and position pertaining to the Recommended Alternative (National Economic Development Plan) to be addressed by the Corps of Engineers (Corps) in the Final Revised Supplemental Environmental Impact Statement (FRSEIS). This constitutes the report of the Secretary of the Interior as required by section 2(b) of the FWCA (16 U.S.C. 661 *et seq.*) and is intended to accompany the FRSEIS. The Corps has implemented an accelerated schedule for completion of the FRSEIS, thus preventing the Service from fully coordinating this report with the Missouri Department of Conservation prior to its finalization, as required by the FWCA. Considering the significant fish and wildlife resource losses associated with this project and that no feasible means exist with the Recommended Alternative to adequately mitigate these impacts, we believe it is imperative that this report is in the FRSEIS. The Service has provided the report to the Missouri Department of Conservation (MDC) for review and fully explained the consequences if the report was not finalized immediately. Upon receipt of MDC's comments, the Service will issue a revised report.

Due to the Corps' accelerated schedule, we were unable to complete certain evaluations (e.g., Waterfowl Assessment Methodology) and review specific data and evaluations (e.g., Habitat Evaluation Procedures) conducted by the Corps and its contractor. Furthermore, the Service did not receive information requested from the Corps necessary to completely evaluate project-related fish and wildlife losses. Therefore, this FWCA report is in an abbreviated format, without a quantitative analysis or the " with and without project" evaluation typically used in FWCA reports. However, such evaluations were previously completed by the Service for other alternatives (authorized and avoid and minimize alternatives) which are similar to the Recommended Alternative/NED Plan. During the past two years, the Service has provided the Corps with several key documents describing fish and wildlife resources and their significance in the project area, evaluating the effect of the project on these resources, and recommending measures to properly mitigate project induced losses. To accommodate the expedited process, we hereby incorporate by reference the following documents: 1) February 26, 2002, comments from the Department of Interior on the draft Revised Supplemental EIS; 2) October 16, 2001, FWCA letter-report; 3) July 12, 2001, letter to the Corps concerning New Madrid Floodway operations; 4) June 7, 2001, EIS scoping letter; and 5) June 7, 2000, letter and accompanying May 2000 final FWCA report.

Impacts of the Recommended Alternative/NED Plan on Fish and Wildlife Resources

The Recommend Alternative/NED Plan (Alternative 3-1B) is a slight variation of the Authorized Project and the Corps' Avoid and Minimize Alternative in the previous Final EIS. It is important to note that the suite of 9 variations under the Corps' current Avoid and Minimize Alternative (Alternative 3) is a misnomer. The proposed project design changes and actions do nothing to avoid fish and wildlife resource losses and the minimization measures are nominal considering the significant scope and magnitude of these losses.

Project design, objectives, fish and wildlife impacts, and mitigation features associated with the St. Johns Bayou Basin portion of the project remain the same with the Recommended Alternative as previously evaluated by the Service and addressed in the Corps' draft Revised Supplemental EIS. The only difference between the Recommend Alternative/NED Plan and the basic "Avoid and Minimize" Alternative is modified gate and pump operations for New Madrid Floodway levee. The Service has presented to the Corps detailed fish and wildlife impact analysis and recommendations on the Authorized and Avoid and Minimize alternatives in previous documents. We do not restate this information in this report and recommend these Service reports be reviewed for additional information.

Under the Recommended Alternative, the gravity gates in the New Madrid Floodway levee would be open from March 1 to May 15 each year and backwater flooding from the Mississippi River will be allowed to enter the Floodway until the river reaches an elevation of 284.4 NGVD. At this elevation the gates would be closed and the pump would be turned on to evacuate backwater and internal flooding from the Floodway until water elevations in the sump reach 283.4 NGVD. The Corps' intent with this operation is to provide some connectivity between the Mississippi River and the Floodway for fish and to partially compensate for the loss of fish spawning/rearing habitat when the 1,500 foot gap in the levee is closed. The Corps' has calculated that this gate/pump operation will provide approximately 1,036 acres of mid-season floodplain habitat for fish spawning and rearing. The Corps also plans to purchase flowage easements up to elevation 284.4 in the Floodway to allow spring flooding in association with the modified gate operations for spring waterfowl habitat.

Although this modified gate operation is an improvement in project design over previously proposed alternatives, it falls far short of reducing the significant impact that closing the levee gap will have on the valuable fishery. The 1,036 acres of fish spawning and rearing habitat predicted by the Corps is minuscule compared to the habitat area normally provided when Mississippi River backwater flooding occurs in the Floodway. For instance, during several recent years (i.e., 2002, 1998, 1997, 1996, 1995, 1994, and 1993) backwater flooding in the Floodway exceeded elevation 292, providing over 30,000 acres of fish spawning and rearing habitat.

Biological and technological problems associated with the gate/pump operation indicate that it may provide little or no compensation for the loss of fish spawning/rearing habitat and productivity and limited opportunity to maintain a semblance of river-floodplain connectivity. The Service consulted Dr. Harold Schramm, Jr., Unit Leader, U.S. Geological Survey-Biological Resources Division's Mississippi Cooperative Fish and Wildlife Research Unit, on this and other issues relating to the project's effects on fishery and aquatic resources. Concerns by the Service and Dr. Schramm relating to the New Madrid Floodway gate operations are detailed below:

1. Studies/Predictive Models - No studies or predictive models have been conducted to determine the biological consequences (both on the Floodway and the Mississippi River) of reducing the river-floodplain connectivity to a 10-foot by 10-foot culvert. This includes studies to assess impacts on fish movement with the closure structure and which fish species currently using the floodplain could be excluded with gate operations. The fisheries Habitat Evaluation Procedures (HEP) did not evaluate impacts of the levee closure or gate operation but analyzed impacts solely on inundation, season, and land cover. HEP does not have the capability to evaluate the river-floodplain connectivity problem or its associated effects on fish production. The Corps stated in the draft EIS that high water velocities, restricted openings, and head differentials could adversely effect fish movement into the Floodway. The Corps then dismisses this concern based on the presence of fish in the St. Johns Bayou Basin, which they claim demonstrates that fish can move through the gates/culverts. However, no studies have been conducted in the St. Johns Bayou documenting the scope and extent of fish movement between the river and the basin. Furthermore, the Corps failed to consider that the St. Johns Bayou Basin has a completely different type of fishery and currently does not have a pump (see discussion below on effects of pumps on the fishery.

2. Timing of Gate Opening and Fish Movement - It is estimated that the gates would be open for an average of 14.3 days in March and 12.9 days in April, generally during lower river stages. Not all fish move onto the floodplain under the same conditions (e.g., water temperature, rising water) and none move according to the calendar. If water rose early, the gates could be closed before any fish moved into the Floodway. During a rapid river rise, the Floodway may only be accessible for a few days. And, if the gates closed after fish moved into the Floodway, they would be prevented from returning to the river.

3. Pumps - No studies have been conducted to determine the effects of operating the pumps in both the New Madrid Floodway and St. Johns Bayou Basin on fish populations.

The entrainment of fish through the powerful pumps could kill a large number of fish in addition to mortality caused by dewatering. Any fish production that would result from gate operations in both areas could be negated when pumps are operated.

Project induced wetland losses and the lack of scientific documentation concerning the scope and magnitude of these losses continues to be a serious problem with this project and the Recommended Alternative. The Corps claims that wetlands will retain sufficient hydrology (e.g., saturation), however other economic and engineering data produced by the Corps and the purpose and desired economic outcome of this project contradict this claim. The Corps has also stated that some wetland functional values will be lost or reduced but that these losses will be adequately offset by its mitigation plan. In fact, the Corps' mitigation objectives provide for 100 percent offset of all wetland losses. Armed with the volumes of scientific literature on wetland ecology and the effects of drainage projects on wetlands, a reasonable person could conclude that this project will have profound impacts on wetland hydrology and that the designed drainage features completely eliminates the ability to maintain and restore (for mitigation) wetlands in the project area. One simply has to view the current landscape and history of wetland drainage in the Missouri Bootheel to predict the plight of wetlands in the St. Johns Bayou and New Madrid Floodway. The Corps has consistently rejected the Service's and other agencies' assessment of wetland impacts and mitigation capability, even though these assessments are substantiated by scientific studies of wetland losses associated with similar federal flood control/agricultural drainage projects in the Lower Mississippi River Basin. Despite repeated requests from the Service, no studies or predictive models have yet to be used to quantify project effects on wetlands and their functional values and wetland restoration potential post-project. Without this scientific information, the Corps' undocumented claims of wetland impacts and mitigation potential can not be validated.

The Corps proposed in the draft RSEIS additional environmental features into the project design and the Service assumes these are now part of the Recommend Alternative/NED Plan. These features include placing buffers on 64 miles of streams and channels in the project area, construction of artificial fish structures, and development of a wildlife corridor between Big Oak Tree State Park and Ten Mile Pond Conservation Area. The Corps stated the following three reasons for including these measures: 1) uncertainties regarding acquisition of the most desirable lands; 2) effectiveness of management of those lands; and 3) values placed on the lower Floodway. The Service supports these additional environmental measures and recommend that they be incorporated into the Recommended Alternative or any other future plans for this project. Although these measures are beneficial, they do not make the project environmentally acceptable.

There are no additional effects to federally listed threatened and endangered species with the Recommended Alternative beyond those that were previously addressed in the Service's June 11, 1999, Biological Opinion. Therefore, no additional consultation under section 7 of the Endangered Species Act is necessary.

Recommendations

Based on the magnitude of fish and wildlife losses, value of these resources, and the inability to properly mitigate these losses due to the design, purpose and economic objectives of the project, the Service recommends that the Recommended Alternative/NED Plan (Alternative 3-1B) not proceed as formulated. Other alternatives that provide greater opportunity to minimize and compensate fish and wildlife losses, such as presented in the Department of Interior's February 26, 2002, letter, should be more fully evaluated and incorporated into a limited project.

The following recommendations pertain to the Recommended Alternative/NED Plan (Alternative 3-1B). Several of these recommendations were contained in the May 2000 FWCA report and have been updated. Providing these recommendations does not change the Service's opposition to the Recommended Alternative nor indicates that implementing these recommendations will fully compensate for project-related fish and wildlife losses. The Service is aware that specific purposes and features of the project may prevent many of these recommendations from being implemented if the project is constructed (e.g., permanent change in wetland and fishery hydrology, inability to locate suitable sites with willing sellers, and effect on project economics of removing lands from agriculture production for mitigation). Furthermore, we fully expect that these recommendations will be rejected as infeasible or unjustified by the Corps and the local sponsor or reduced in scope to the point of becoming virtually meaningless as compensation measures. These recommendations are provided by the Service to rectify and compensate for a portion of the anticipated impacts in the event that the Recommended Alternative is approved, funded, and constructed over our objections.

Recommendation 1: Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:

Recommendation 1a: Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

Recommendation 1b: Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

Recommendation 1c: Constructing a low-head weir where the Lee Rowe Ditch branches off the St. James Ditch to prevent perching that channel during base flows.

Recommendation 1d: Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower depths along those reaches. They may function as grade control structures.

Recommendation 1e: Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James Ditch that contains suitable habitat for the State-listed golden topminnow.

Recommendation 1f: Avoiding dredging in a nine-foot strip along the right-descending side of the Setback Levee Ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from sites within the dredge path to other appropriate areas in the St. Johns Bayou Basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

Recommendation 2a: Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns Bayou Basin and between 290 and 284.4 (NED) NGVD in the Floodway. The Service assumes the Corps will purchase flood or similar easements up to elevation 284.4 that will include covenants to prevent the clearing of forested wetlands.

Recommendation 2b: Compensation for unavoidable losses of fish and wildlife resources should include the following measures (average annual acres).

(1) Reforest approximately 1,550 acres of agricultural lands and maintain appropriate hydrologic conditions on these areas to partially compensate for forested wetland habitat losses associated with channel enlargement, levee closure, and pump operations (i.e., altered hydrology). If protective covenants are not placed on forested wetlands as described in 2(a) above, the Corps should reforest an additional 6,788 acres to compensate for induced forested wetland losses.

(2) Reforest cropland and maintain appropriate hydrologic conditions to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

(3) Reforest approximately 7,058 acres (based on information in Table 14, Appendix G in the draft RSEIS) of seasonally flooded agricultural lands that has unimpeded access for river fishes during the reproductive season (i.e., March through June) to partially compensate mid-season fisheries spawning and rearing habitat losses on the floodplain (excluding permanent water bodies in #4 below). Lands behind existing levees with impeded access for fishes (i.e., St. Johns Bayou Basin) and areas in the New Madrid Floodway after the levee gap is closed do not meet the definition of "unimpeded access". Enhancement of batture lands would also not be acceptable compensation for fisheries spawning and rearing habitat losses because it would provide little additional fish and wildlife benefit above existing conditions, and both the hydrologic and temperature regimes of these areas differ significantly from those of the Floodway.

(4) To the maximum extent feasible, provide approximately 1,950 acres of in-kind compensation for the loss of permanent waterbodies. Compensation actions should involve restoring/reconnecting old chutes, sloughs, and oxbows with the Mississippi River and/or improving habitat values of existing permanent waterbodies. Borrow pit construction provides minimal permanent water habitat for fishes and is not considered adequate compensation. If in-kind replacement is infeasible, reforest an additional 1,950 acres of flooded cropland with unimpeded access for river fishes to compensate permanent waterbody losses. The Corps should ensure public access to these sites through fee-title purchase or easements.

(5) Provide approximately 1,500 acres of shallow flooded (i.e., < 18 inches) agricultural lands in April and May to compensate for project-related losses in shorebird migration habitat. Depending on development and management practices, these shorebird mitigation sites could also partially compensate for waterfowl habitat losses. Constructing moist soil areas to replace these losses would reduce the area needed for mitigation to 770 acres.

(6) Acquisition of mitigation lands (including easements under recommendation 2a), reforestation, and shorebird management measures should be accomplished concurrently with project construction and should be in place prior to project operation.

Recommendation 3: Acquire and restore (reforestation and hydrology) sufficient lands around Big Oak Tree State Park to provide a buffer and to compensate for impacts to the ecologic and biological functions and values of the Park and the federally designated National Natural Landmark. These lands would be managed by the Missouri Department of Natural Resources as a unit of the State Park.

Recommendation 4: Develop and implement a plan, in cooperation with the Missouri Department of Natural Resources and the National Park Service, to maintain and restore wetland hydrology in Big Oak Tree State Park and the National Natural Landmark.

Recommendation 5: Develop and implement a program, in cooperation with the Service and MDC, to monitor the fish and wildlife effects of the project and the performance of all mitigation measures ultimately implemented. The monitoring program should address all aspects of fish and wildlife impacts and mitigation, including hydrologic changes in wetland and fishery habitats and landuse changes (e.g., conversion of wetlands to agriculture production). The monitoring program should be in place prior to operation and operational for a minimum of 25 years.

Recommendation 6: Conduct an independent, scientific review of the project to resolve the longstanding disagreement between the Corps and the Service concerning the expected environmental impacts of this project, especially relating to wetland and fishery losses.

Recommendation 7: Develop and implement an adaptive management program, in cooperation with the Service and MDC, that provides flexibility to add or revise fish and wildlife mitigation components based on scientific review and monitoring as addressed in recommendations 5 and 6 above. Three critical issues that will require close monitoring and have a high probability of requiring future corrective actions are: 1) the ability of fish to freely access the floodway-river through the New Madrid Floodway gates and pumps during the seasonal flooding regime proposed under the Recommended Alternative; 2) the fixed timing of gate operations in relationship to fish movements and reproductive periods; and 3) the extent of reduced wetland hydrology and its impairment of wetland ecological functions, which may be greater than the Corps has predicted.

Recommendation 8: All project mitigation components and the monitoring and adaptive management programs should be formalized under an Environmental Operating Plan (EOP). The EOP would establish monitoring standards and criteria to assess mitigation performance and integrate information from the scientific review and monitoring program with decisions concerning future remedial actions (adaptive management). The Corps should diligently pursue the necessary authorizations and appropriations to guarantee that the EOP is a viable component of the project and is in place prior to project operation. The following three tasks should be completed concurrent with completion of the FRSEIS and Record of Decision:

a. The Corps should secure Congressional authorization for an appropriate portion of the construction funds to be set aside to accomplish any remedial or mitigation actions dictated by the EOP.

b. Annual funding to implement the EOP should be linked directly to overall operational funds for the project. Authorization to use a proportion of annual operating funds for these purposes should be obtained in Congress.

c. In order to effectively implement the EOP and achieve any remedial measures dictated through monitoring and adaptive management, an operations committee should be authorized by Congress. This body should consist of technical personnel from the Corps, Service, MDC, Missouri Department of Natural Resources, and the local sponsor.

Position of the U.S. Fish and Wildlife Service on the Recommended Alternative

The goal of the U.S. Fish and Wildlife Service and Missouri Department of Conservation concerning the St. Johns Bayou and New Madrid Floodway Project is that fish and wildlife resources and the habitats upon which they depend be conserved and properly mitigated through balanced project planning, implementation and operation. This basic goal is supported by language in the Fish and Wildlife Coordination Act, which states that wildlife conservation shall receive equal consideration with other features of water resource development projects. The Fish and Wildlife Coordination Act further requires the Corps to give full consideration to the report and recommendations of the Secretary of the Interior as contained herein.

The Service is opposed to the Recommended Alternative/NED Plan for the St. Johns Bayou and New Madrid Floodway Project and recommend that it not go forward as formulated. Implementation of the Recommended Alternative will result in significant losses of regionally and nationally important fish and wildlife resources which can not be adequately mitigated due to project design and economic objectives. The Recommended Alternative will significantly reduce the duration and frequency of flooding on 130,000 acres of Mississippi River floodplain, adversely impact a regionally important fishery (including an economically viable commercial fishery) by eliminating the last remaining connection of the Mississippi River with its historic floodplain in Missouri, result in the elimination or major degradation of over 18,000 acres of wetland habitat and their ecological functions, and cause further decline in the biological and ecological integrity of a federally designated National Natural Landmark. Proceeding with this project with the knowledge that there are no feasible means to minimize, compensate, or remediate these adverse environmental impacts directly conflicts with the spirit and intent of the Fish and Wildlife Coordination Act. The project, as presently formulated, provides only superficial consideration of fish and wildlife resources while maximizing the national economic benefits. This project takes the most expedient route to provide flood control and drainage of agricultural lands (for the intensification/diversification of crop production) at great cost to fish and wildlife resources and related environmental resources in Missouri and the Lower Mississippi River Basin.

Although the Service is opposed to the Recommend Alternative, we are prepared to work with the Corps, the local sponsors, and other agencies to formulate a more environmentally acceptable project. The Department of the Interior and Service recommended a solution in its February 26, 2002, comments on the draft Revised Supplemental Environmental Impact Statement that would minimize some of these environmental impacts while providing benefits from reduced flooding in the town of Pinhook and facilitate increased agricultural production in the Floodway. This solution involved selecting one of the two uppermost setback levees (Alternatives 7-2 and 7-3 in the draft RSEIS) in the New Madrid Floodway. We strongly encourage the Corps to reconsider its selection of the Recommended Alternative and reformulate the project centered around one of these setback levees.

I look forward to discussing with you our concerns and recommendations presented in this FWCA report and how these recommendations and the comments submitted on February 26, 2002, are addressed in your Final Revised Supplemental Environmental Impact Statement.

Sincerely,

Charles M. Scott

Charles M. Scott
Field Supervisor

cc: Regional Director, FWS, Minneapolis, MN (ES)
Regional Director, NPS, Omaha, NE
Acting Director, Missouri Department of Conservation, Jefferson City, MO
Director, Missouri Department of Natural Resources, Jefferson City, MO
Regional Administrator, EPA, Kansas City, Kansas (Attn: Joe Cothern)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Columbia Ecological Services Field Office
101 Park DeVille Drive, Suite A
Columbia, Missouri 65203-0057
Phone: (573) 234-2132 Fax: (573) 234-2181

March 15, 2006

Colonel Charles O. Smithers III, District Engineer
U.S. Army Corps of Engineers
167 North Main Street B-202
Memphis, Tennessee 38103-1894

FILE COPY

Dear Colonel Smithers:

This constitutes the U.S. Fish and Wildlife Service's (Service) Supplemental Fish and Wildlife Coordination Act (FWCA) Report for the St. Johns Bayou and New Madrid Floodway Project, Missouri. This Supplemental FWCA Report pertains to revised fish and wildlife mitigation measures proposed by the Corps of Engineers (Corps) in its December 2005 Draft Revised Supplemental Environmental Impact Statement 2 (DRSEIS 2). This Report supplements the analyses and recommendations provided by the Service in previous FWCA reports, planning aid letters, and comments on prior environmental impact statements.

Since July 2005, the focus of the Corps' planning efforts for this project, as reflected in the DRSEIS 2, has involved a major re-evaluation of measures to compensate for project caused fishery losses in the New Madrid Floodway. In June 2005, the Corps decided to withdraw its 2003 Record of Decision for the project and conduct this re-evaluation due to an error in how it addressed fishery impacts and mitigation needs in the 2002 Revised Supplemental Environmental Impact Statement (RSEIS).

Early in the planning process for this project, the Habitat Evaluation Procedures (HEP) Team, which consists of the Corps, Service, and Missouri Department of Conservation (MDC), agreed upon a fish model to be used in evaluating the project's impacts and mitigation needs for fish rearing. Using this model, the HEP Team determined that 8,375 Average Daily Flooded Acres (ADFAs) were needed to compensate for fish rearing losses. This mitigation benchmark was subsequently addressed in the Service's FWCA Reports. However, as a basis for determining mitigation requirements in the 2002 RSEIS, the Corps used 8,375 acres instead of 8,375 ADFAs. Due primarily to the drainage and flood damage reduction objectives of the project, more than 8,375 acres are needed to achieve 8,375 Average Daily Flooded Acres. Thus, the mitigation needs for the project were underestimated in the 2002 RSEIS.

To address this deficiency in fishery compensation, the Corps identifies additional conceptual mitigation measures in the DRSEIS 2. Among the measures the Corps proposes are four categories of measures to add ADFAs and Average Annual Habitat Units (AAHUs) for fishery compensation: (1) modification of the design of construction borrow pits; (2) modification of gate operations; (3) creation, restoration, or enhancement of large permanent water bodies -

primarily existing Mississippi River floodplain lakes (oxbows) located on batture lands, such as Riley Lake; and (4) reforestation of batture lands. These proposed mitigation categories can be further categorized as those occurring inside the project area (Nos. 1 and 2) and those outside the project area (Nos. 3 and 4).

The measure involving modification of the design of construction borrow pits is incorporated by the Corps into a "basic mitigation feature," which includes most of the mitigation features presented in the 2002 RDEIS and stipulated in the section 401 Water Quality Certification issued by Missouri Department of Natural Resources. The measures in the remaining three categories are identified by the Corps as additional measures to compensate for fishery losses remaining in the New Madrid Floodway. These three categories are presented by the Corps in the DRSEIS 2 in four "mitigation scenarios," with varying costs and acreages, with the "basic mitigation feature" being a part of each scenario.

The Corps provides a brief description of two other measures to compensate for the loss of fish rearing habitat in the New Madrid Floodway: (1) increasing flood duration on reforested areas from April 1 to May 15; and (2) restoration of small, permanent water bodies within the project area. However, neither in its presentation of the four mitigation scenarios discussed above nor in other descriptions of these measures in the DRSEIS 2 does the Corps define any values (AAHUs) for these other measures in compensating for New Madrid Floodway fish rearing losses. The Service focuses its analysis and comments provided below on the four categories of measures where the Corps has assigned compensation values.

Modification of the Design of Construction Borrow Pits

The Corps plans to construct 387 acres of borrow pits in the lower area of the St. Johns Bayou as it borrows material for levee construction. The Corps now proposes to modify the design of these pits to improve fishery habitat by providing a diversity of water depths and sinuous shorelines, establishing islands, and placing structures (i.e., trees). According to the Corps, the borrow pits will increase the compensation for lost fish rearing habitat because they will provide permanent water bodies during the fish rearing season and will be designed to allow free ingress and egress of Mississippi River fishes during flood events. The Corps believes these modified borrow pits will provide high quality habitat supporting a high density of fish and diversity of fish species and could provide an additional 1,571 fish rearing AAHUs.

During all previous mitigation planning efforts for this project, the Corps, Service, and MDC agreed that modified borrow pits would only be considered as compensation for project-caused losses of other permanent water bodies – not as compensation for the loss of river-floodplain connectivity and fish rearing habitat in the New Madrid Floodway. The Corps presents no information in the DRSEIS 2 concerning how these borrow pits would be designed to provide access for Mississippi River fishes. Furthermore, anecdotal information, not scientific documentation or predicative models, is used in the DRSEIS 2 to describe the ability of Mississippi River fishes to use these structures in completing their reproductive life cycle. The Service acknowledges that there is limited movement of fishes through the gates in the St. Johns Bayou. However, the extent of fish movement into the St. Johns Bayou is considerably less than the unrestricted access that River fishes currently have into and out of the New Madrid Floodway.

Modification of Gate Operations

The Corps is proposing to modify the gate operations in the New Madrid and St. Johns Bayou to provide compensation for the loss of fish rearing habitat caused by the closure of the New Madrid Floodway. In the 2002 RSEIS, the Corps proposed a compensation measure that left the gates in the New Madrid Floodway open to an elevation of 284.4 feet NGVD when the Mississippi River is flooding during the period April 1 to May 15. When river flood levels drops below 284.4 feet NGVD, the gates would be opened to allow for the draining of water that had pooled inside the Floodway. The new proposed gate operation would still have the gates open until river flooding reached 284.4 feet NGVD, at which time they would be closed. The proposed change involves leaving the gates closed after river levels drop, thereby creating a pool behind the gates until May 15, at which time the gates would be opened and the pooled water would be drained.

The Corps presents four different scenarios for gate operations for the New Madrid Floodway. Three of the scenarios involve holding the pool elevation constant at 284.4 feet, 283.4 feet, or 282 feet NGVD over the entire period of April 1 to May 15. In the fourth scenario, the pool elevation would be at 284.4 feet from April 1 to April 30 and 283.4 feet from May 1 – May 15. The ponded area in the New Madrid Floodway created by the modified gate operations corresponds to the project sump area, as described in the 2002 RSEIS. The size of the sump area is approximately 2,000 acres, of which 800 acres is currently enrolled in the Wetland Reserve Program (WRP). The sump area is the lower elevation portion of the Floodway where the new pumps would operate to evacuate interior drainage water when the river is in flood stage and the gates are closed. Under the current proposal, the pumps would be used to remove interior water to an elevation of 284.4 feet NGVD (or to the elevation described in the other three gate scenarios). In the DRSEIS 2, the Corps also provides a similar modified gate operation for the St. Johns Bayou, although with only one elevation (283 feet) for the entire period.

The Corps believes the ponded area created by these modified gate operations would provide fish spawning and rearing habitat that is comparable to the habitat that currently exists in the Floodway during flood events. The Corps states that fish will enter the Floodway and the pooled area while the gates are open, complete spawning and rearing in the impounded pool, and return to the river when the gates are re-opened. For the New Madrid Floodway, the Corps identifies the following range of fish rearing compensation values for this measure: 2,000 acres (at 284.4 feet NGVD) to 853 acres (at 282 feet NGVD) of spawning and rearing habitat; 1,531 ADFAs (at 284.4 feet) to 707 ADFAs (at 282 feet); and a gain in AAHUs ranging from 2,699 (at 284.4 feet) to 1,145 (at 282 feet).

The importance of the Floodway in providing Mississippi River fishes open access to valuable backwater habitat to complete reproductive and early life stages has been well documented by the Service, MDC, Corps, and several researchers. To qualify as in-kind compensation, a mitigation measure must allow river fishes to enter and leave the Floodway unabated. Such mitigation measures must ensure successful fish recruitment – otherwise, the mitigation will fail to achieve its intended purpose. Factors that should be considered include the natural timing of fish movements in relation to their reproductive cycles and river stages, water temperature and other water chemistry, and habitat that allows young fish to avoid predators.

The Corps has not provided information indicating that it has consulted with fish-passage engineering experts or that it has conducted any fish-passage studies to scientifically evaluate the ability of river fishes to freely access the Floodway through the gates. On several occasions, the Service has requested such an evaluation, including in our August 11, 2005, Planning Aid Letter. Furthermore, information is needed to determine if such artificially created habitats would provide the other necessary features (e.g., timing, temperature) for successful fish recruitment. Without conclusive information on this issue, the Service maintains its position that in-kind compensation of fish spawning and rearing habitat cannot be achieved inside of the Floodway with the proposed project. The Service recommends that the proposal to modify gate operations to pond water for fish spawning and rearing be withdrawn from consideration as a fishery mitigation measure until these studies have been completed.

Creation, Restoration, or Enhancement of Large, Permanent Water Bodies

With this category of mitigation measures, the Corps is proposing to compensate for the loss of New Madrid Floodway fish spawning and rearing habitat by modifying oxbow lakes and chutes that occur on the Mississippi River floodplain (batture lands). A number of such floodplain lakes exist in the batture. These lakes are an integral component of the river's ecosystem. There are now fewer of these oxbows lakes and chutes due to the restriction of the Mississippi River floodplain by extensive levees and training dikes. Typically, during normal river flows, these depressional areas of the floodplain are not directly connected to the river. Some river fishes remain in these oxbow lakes after flood waters recede. However, because the substrates of these oxbows consist of permeable, alluvial soils, the water levels in them equalize with river levels, resulting in the oxbows becoming very shallow or completely dewatered after flood waters recede.

The Corps' proposal involves modifying these oxbows to provide more surface area of water and greater water depths. By converting these lakes to hold more water, the Corps believes the lakes will provide greater habitat value for fish spawning and rearing, thus providing compensation for the loss of the fish habitat in the Floodway. Furthermore, the Corps states in the DRSEIS 2 that providing greater water depths in the oxbows after the river has receded will improve fish survival and contribute to recruitment of the river's fishery when they are re-flooded.

The Corps uses Riley Lake, located at the tip of Donaldson Point, to describe how the oxbows could be modified to compensate for the loss of fish spawning and rearing habitat. A weir structure would be placed in Riley Lake that would impound water at a specific elevation after flood waters recede. For instance, under normal conditions, Riley Lake contains 36 acres of permanent water surrounded by bottomland hardwood forest and farmland. If a weir were constructed with the control elevation set at 285 feet NGVD, 112 acres of bottomland hardwood forest and 97 acres of farmland would be inundated, along with the original 36 acres of the lake, providing a total of 245 acres of permanent water and 399 AAHUs of fish rearing habitat. With a weir set at an elevation of 289 feet NGVD, 295 acres of hardwood forest and 349 acres of farmland would be converted, providing a total of 680 acres of permanent water and 1,290 AAHUs of fish rearing habitat (Table 2.4 of DRSEIS 2). The fish recruitment concept promoted by the Corps is that river fish trapped in the converted lake as flood waters recede would reproduce and some of these adults and their progeny would return to the river in the next flood event. This cycle would be repeated with each flood event. In Table 2.3 of the DRSEIS 2 (Page 40), the Corps identifies seven other oxbow lakes that could potentially be modified.

The Service considers the conceptual proposal for Riley Lake to be a conversion of valuable, existing habitat types to an alternative habitat type. The conversion of oxbow lakes to permanent water bodies will replace areas that currently provide fisheries habitat and Mississippi River ecological functions. In addition, the proposal for Riley Lake will result in the loss of valuable floodplain hardwood forests, with no compensatory mitigation proposed to offset this loss (Page 40 of DRSEIS 2). The DRSEIS 2 does not indicate the acreage of hardwood forest that would be lost with the possible increase in surface area of permanent water at each of the other floodplain lakes identified in Table 2.3 as possible sites for such conversions.

Furthermore, there might be a major constraint in modifying areas like Riley Lake to provide more permanent water. Creating an impoundment through the use of a weir might not maintain greater water depths for an extended period if the alluvial soils underlying Riley Lake are highly permeable. If this is the case, water elevations will drop to equalize with the river's water surface elevation. This could be the case with most of the oxbows and chutes on the Mississippi River floodplain. Prior to committing to the possible use of this mitigation measure, the Corps (if it has not already done so) should determine if these floodplain lakes can maintain greater water depths for extended periods of time as water levels on the river fall.

Reforestation of Batture Lands

For two of the mitigation scenarios in the DRSEIS 2 (Scenarios A and C), the Corps proposes that reforestation of batture lands will compensate for the loss of fish spawning and rearing habitat in the New Madrid Floodway. Under Scenario A, reforestation of 200 acres of batture lands would add 19 AAHUs. Under Scenario C, reforesting 1,050 acres would add 117 AAHUs for the New Madrid Floodway losses.

The Service acknowledges that the reforestation of batture lands could improve fishery habitat value of these areas and is not opposed to the Corps implementing this action. However, replanting trees on the batture lands cannot provide in-kind replacement or compensation for the loss of backwater spawning and rearing habitat in the Floodway. These are two separate areas and two different kinds of fishery habitat. The Service has repeatedly stressed throughout the multiple mitigation planning cycles for this project that restoring or enhancing the habitat value of the batture lands for Mississippi River fishes does not address compensation in the Floodway.

Summary and Recommendations

Throughout the years of our involvement with the planning of the St. Johns Bayou and New Madrid Project, the Service has placed special emphasis on the critical importance that the Mississippi River-New Madrid Floodway connection has in providing valuable fishery resources and ecosystem functions. This has remained our highest mitigation priority because this river-floodplain connection is absolutely vital to maintaining a healthy, sustainable fishery in this section of the Mississippi River. Completing the closure of the New Madrid Floodway will eliminate a major area of river-floodplain connectivity in this region of the River and the very last area of its kind in the State of Missouri.

The exceptional value of backwater areas of the Mississippi River to the River's regional fishery and the on-going threats to these backwater areas requires that we continue to explore and implement mitigation measures that avoid and minimize further losses. The Service is unaware of any feasible mitigation techniques that can provide in-kind replacement to offset the permanent loss of this habitat and associated ecological processes. We appreciate the Corps' efforts in evaluating and presenting a variety of ideas to compensate for the fish habitat losses associated with the New Madrid Floodway closure. However, the Service cannot concur that the Corps' mitigation proposals presented in the DRSEIS 2 will sufficiently mitigate for the project-caused fish habitat losses in the New Madrid Floodway.

The Service's position on this issue has not changed from our previous FWCA Reports. We continue to recommend that the Corps and the project sponsor re-evaluate and formulate plans that involve measures to minimize, not attempt to compensate, the loss of the Floodway's fishery habitat and the river-floodway connection. We still believe that a setback closure levee could be constructed in a manner that meets the flood-reduction objectives of the projects; provides economic benefits to Floodway farmers, residents, and local communities; and minimizes the loss of the irreplaceable fishery resources. It is our hope that we can begin to collaboratively develop a set of plans that incorporates all of these important features.

We appreciate the opportunity for the Service to participate in this updated mitigation planning effort and look forward to working with the mitigation team in making progress in the development of a fully functional mitigation plan. We want to take this opportunity to provide specials thanks to two people on your staff, Danny Ward and Kevin Pigott. Mr. Ward and Mr. Pigott were always cooperative and timely in answering our questions, providing us with updated information, and assisting the mitigation team in other ways during our participation with this mitigation planning effort.

Please do not hesitate to contact me if you have any questions concerning any information presented in this Supplemental FWCA Report.

Sincerely,

Charles M. Scott

Charles M. Scott
Field Supervisor

cc: RD, FWS, Ft. Snelling, MN (ES)
Director, MDC, Jefferson City, MO (Policy Coordination)

O:\Scott\SJNM-Supp.FWCArpt-MAR08.doc

United States Department of the Interior
OFFICE OF THE SECRETARY
Washington, DC 20240

TAKE PRIDE IN AMERICA

AUG 26 2011

The Honorable Jo-Ellen Darcy
Assistant Secretary
U.S. Army, Division of Civil Works
441 G. Street, NW
Washington, DC 20314-1000

Dear Assistant Secretary Darcy:

As you may be aware, in 2008 the Memphis District Corps of Engineers (Memphis District) began another round of planning and environmental evaluations for the St. Johns Bayou-New Madrid Floodway Project in New Madrid County, Missouri. This is a highly controversial flood control project. A 2007 ruling by Judge James Robertson of the US District Court for the District of Columbia set aside the Corps Environmental Impact Statements (EIS) and Record of Decision (ROD), enjoined the Memphis District from proceeding with the project, and ordered the deconstruction of those portions of the project that were already built. This litigation dealt with how the Memphis District presented information in the EISs and ROD on impacts to fish and wildlife and proposed measures to mitigate these impacts. The Department of the Interior (DOI) and the U.S. Fish and Wildlife Service (Service) have long-standing concerns with this project, including the ongoing re-assessment.

Two recent events have heightened our concerns and prompted the urgency for resolution: 1) the July 2011 release of the draft Agency Technical Review (ATR) EIS, which proceeds with the same plan and mitigation techniques addressed in previous EISs; and 2) the May 2011 operation of New Madrid Floodway to abate flooding on the Lower Mississippi River, which accentuates the environmental, economic, and flood management value of the river-Floodway connection. In this regard, we urge the Council on Environmental Quality (CEQ) and the Corps of Engineers (Corps) to take the lead in formulating a unified Administration position that adequately addresses the significant environmental impacts associated with the current project while reducing flood impacts to infrastructure in the area.

In September 2010, the Missouri Delegation wrote to the President; the Honorable Nancy Sutley, Chairwoman, White House Council on Environmental Quality; and the Honorable Lisa Jackson, Administrator for the U.S. Environmental Protection Agency, urging support for the St. Johns Bayou-New Madrid Floodway Project. The views of the Department on this project reflect over three decades of active environmental review by the Corps and our agencies, a review that has produced a voluminous body of scientific evidence. This review has produced six major volumes of draft or final environmental impact statements, extensive Fish and Wildlife Coordination Act reports and multiple rounds of comments by the Department and Environmental Protection Agency (EPA). The review has also generated extensive scientific reports and commentary about the project from some of this country's most prominent scientists.

It is well established that backwater flooding from the Mississippi River into its floodplain is the driving force behind the ecology of the river. However, the vast majority of this critical connection between the Lower Mississippi River and its floodplain has been extensively levied and drained at great cost to fish, wildlife and water quality. A major component of the New Madrid Floodway project is to close a 1,500 foot gap in the Mississippi River frontline levee. This 1,500 foot levee gap is the last remaining area in the State of Missouri where the Mississippi River is connected to its historic floodplain. Closing this levee gap will eliminate up to 90,000 acres of floodplain that is seasonally connected to the river. Severing this significant river-floodplain area will have profound impact on the river's ecology and valuable fish and wildlife resources within the New Madrid Floodway. Although these seasonally flooded areas are a mixture of naturally vegetated lands and croplands, they provide exceptional value because of the important role that backwater floodplain habitat plays in the ecology of the Lower Mississippi River. Furthermore, these large river-floodplain areas are becoming increasingly scarce on the lower river.

There is ongoing disagreement regarding the total amount of wetlands to be lost with the project. The Memphis District estimates in their draft ATR EIS that there are 13, 651 acres of vegetated wetlands (7,884 acres in the New Madrid Floodway and 5,767 acres in the St. Johns Bayou Basin) within their identified impact zone (five-year flood frequency elevation). Another 17,000 acres of naturally vegetated wetlands are estimated to occur above the five-year flood frequency elevation and an unknown amount of these wetlands could be impacted by the drainage effects of the project. There is a wide disparity in the estimated amount of farmed wetlands in the two basins, with estimates ranging from 520 to 118,000 acres.

Altering the hydrologic regime of the floodway produces a suite of complex and unsolvable challenges in providing adequate mitigation for the wetland, fishery, and floodplain impacts. The primary components of the Corps' proposed plan to mitigate for these impacts involve:

- Artificially operating the new closure gates and pumps
- Planting forest areas and creating managed wetlands on a few thousand acres, a small fraction of the acres to be drained; and
- Creating small, artificially manipulated permanent water bodies.

Such plans are at odds with contemporary understanding of wetland and floodplain science and agency mitigation guidance. This science emphasizes the critical importance of natural hydrology, spatial extent, and landscape position. The science recognizes the importance to habitat values of subtle features of hydrology, including depth, velocity, and timing of flooding and the relationship of one habitat to another. The Corps wetland mitigation guidance specifically endorses these principles.

When planning on the project was reinitiated in 2008, the Corps of Engineers convened an Independent Expert Panel Review (IEPR) to review the environmental impacts and proposed mitigation for the project. The IEPR has completed Phase II of its review and will soon begin Phase III (review of the draft ATR EIS). The IEPR has stated in its reports to the Corps the importance of the river-floodplain connection and associated hydrology in maintaining the integrity of the wetlands and floodplain. In this regard, the IEPR was critical of the Corps' mitigation plan to maintain wetlands and floodplain systems after the project significantly reduces the hydrologic regime of the floodway.

The primary project purpose is to reduce flooding for the intensification and diversification of agricultural production, which comprises 90 percent of the project's economic benefits. Improving agricultural production is an important value, but it does not depend on draining wetlands and severing the river-floodplain connection. Designing a project that focuses on draining such large floodplain/wetland areas for agricultural production when there is a regional and national need to protect areas of human habitation and infrastructure from flooding could be considered an inappropriate use of limited flood management funds. The communities of East Prairie and Pinhook in the project area would benefit from a reformulated project directed more at the protection of infrastructure. The goal should be to design a project that addresses flood damage abatement while safeguarding the existing hydrology and habitat values of the floodplain.

Unless the purpose and alternatives for the New Madrid project have changed since the last evaluation, the Department does not believe it is in the public interest to engage in yet more environmental analysis of this project. If the project purpose is redefined, we believe the agencies can work together to implement a sound project. I suggest a meeting be convened in the near future to discuss a new approach for proceeding on the St. Johns Bayou – New Madrid Floodway Project.

Sincerely,

Eileen Sobeck

Acting Assistant Secretary for Fish and Wildlife and Parks

cc:

The Honorable Nancy Sutley
Chairwoman
White House Council on Environmental Quality
The White House
1600 Pennsylvania Avenue
Washington, D.C. 20500

The Honorable Lisa Jackson, Administrator
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Appendix R

Mitigation Technical Appendix

U.S. Army Corps of Engineers
Memphis District

This appendix is presented to discuss, in detail, the determination of mitigation necessary to compensate for significant impacts to resources for the tentatively selected plan (TSP).

Wetlands

Compensatory mitigation is based on impacted wetland functions, expressed as functional capacity unit(s) (FCU), and not on impacted acreage. Annualized functional capacity index(cies) (FCI) per acre of mitigated area were calculated for each respective basin to determine potential mitigation necessary to compensate for impacts to the tentatively selected plan (Tables 1 and 2). Since tract size is important to some wetland functions, two tract size scenarios were developed for the low gradient riverine backwater (LGRB) subclass. One tract size assumed that mitigation would be accomplished on large, 1,200-acre tracts connected to similarly sized blocks of existing habitat. For example, mitigation areas surrounding Big Oak Tree State Park assumed a large tract size. The other tract size would be accomplished on smaller (less than 1,200 acres), more isolated tracts. A small tract size was assumed for the low gradient riverine overbank (LGRO) subclass, since the majority of existing LGRO sites are isolated and relatively small. A large tract size was assumed for connected depression (CD) restoration sites, since the majority of these sites are located adjacent to existing connected depression areas, such as those found in Big Oak Tree State Park and the Bogle Woods tracts. In all cases, assumptions were made that wetland mitigation would restore suitable microtopographic features, would restore site specific hydrology to the extent allowable, would be planted in the first year of the project, and would be allowed to grow to forest. As with the wetland reserve program (WRP) projections (Appendix M, Part 1), FCIs were annualized using the following year intervals: 0, 1, 5, 15, 25, and 50.

Table 1. FCI/acre used in mitigation calculations in the St. Johns Bayou Basin.

HGM Subclass	LGRB		LGRO	CD
Tract Size	Small	Large	Small	Large
Function	FCI	FCI	FCI	FCI
Detain Floodwater	0.578	0.578	0.636	0.581
Detain Precipitation	0.925	0.925	0.902	N/A
Cycle Nutrients	0.722	0.722	0.622	0.668
Export Organic Carbon	0.702	0.702	0.614	0.629
Maintain Plant Communities	0.749	0.749	0.653	0.635
Fish and Wildlife Habitat	0.265	0.599	0.442	0.602

N/A - Not Applicable

Table 2. FCI/acre used in mitigation calculations in the New Madrid Floodway.

HGM Subclass	LGRB		LGRO	CD
Tract Size	Small	Large	Small	Large
Function	FCI	FCI	FCI	FCI
Detain Floodwater	0.598	0.598	0.636	0.601
Detain Precipitation	0.925	0.925	0.902	N/A
Cycle Nutrients	0.722	0.722	0.622	0.668
Export Organic Carbon	0.722	0.722	0.614	0.649
Maintain Plant Communities	0.736	0.736	0.667	0.579
Fish and Wildlife Habitat	0.246	0.587	0.444	0.588

N/A - Not Applicable

St. Johns Bayou Basin

Table 3 provides a summary of impacts associated with channel modifications and operation of the pumping station in the St. Johns Bayou Basin as well as the amount of mitigation required to compensate for impacts. Mitigation acres are determined by dividing the impact by the corresponding FCI/acre estimated in Table 1. For example, there are 116 FCU impacted in the detain flood water function. Restoring one acre of LGRB provides 0.578 FCU. Therefore, 201 (116/0.578) acres are required to compensate for the impact to the detain floodwater function for the LGRB subclass. Mitigation necessary to compensate for impacts to wetlands is based on the function that requires the greatest amount of mitigation. Therefore, remaining functions would be over-compensated. The greatest amounts of acreage required are highlighted in bold font. Therefore, 201 acres and 623 acres of LGRB and LGRO mitigation, respectively, would be required to compensate for impacts to wetlands as a result of the project.

Table 3. St. Johns Bayou Basin impacts and mitigation necessary to compensate for impacts. Mitigation assumes small tracts of LGRB.

	Impacts (FCU)		Mitigation (acres)	
Function	LGRB	LGRO	LGRB	LGRO
Detain Flood Water	-116	-397	**201**	**623**
Detain Precipitation	0	-307	0	340
Cycle Nutrients	0	-344	0	552
Export Organic Carbon	-115	-319	164	519
Maintain Plant Communities	-50	-374	67	573
Provide Fish and Wildlife Habitat	0	-210	0	476

Although only 201 LGRB acres and 623 LGRO acres are required to compensate for impacts to wetlands, compensating for significant unavoidable impacts to fish and wildlife resources, most notably fish, would also provide wetland mitigation credit. Table 4 provides the gains to wetland functions, by proposed mitigation zone, as a result of all compensatory mitigation measures. Since mitigation to these resources requires a greater amount of acreage, losses to wetlands would be over-compensated. Table 5 provides the gains to wetland functions as a result of all compensatory mitigation measures.

Table 4. Alternative 3.1 compensatory mitigation zone gains to wetlands expressed as FCU in St. Johns Bayou Basin.

Mitigation Zone	HGM Subclass	Acres	Detain Floodwater	Detain Precipitation	Cycle Nutrients	Export Organic Carbon	Maintain Plant Communities	Fish & Wildlife Habitat
BLH Restoration <285'	LGRB	400	232	372	288	280	300	108
BLH Restoration <5-year	LGRB/LGRO[1]	1193/623	690/396	638/562	859/450	835/437	891/467	315/373
Riparian Buffer Strips (Woody)	LGRO	70	44	63	43	43	46	31
Riparian Buffer Strips (Grass)	LGRO	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Ecologically Designed Borrow pits	CD[2]	194	37	N/A	81	76	29	29
Seasonally Inundated Farmland		244	N/C	N/C	N/C	N/C	N/C	N/C

[1]Depending on location, mitigation could be LGRO or LGRB. However for the purpose of this table, 623 acres were assumed to be LGRO. Regardless, a minimum of 397 LGRO FCU is required to compensate for impacts to jurisdictional wetlands.
[2]Borrow pits would be designed so that half of each pit would have an average depth of less than three feet. Wetland vegetation is expected. 387 acres are proposed. Therefore, 194 acres of wetland functions would be provided.
N/A – not applicable
N/C – not calculated but would be calculated during the completion of site specific detailed mitigation plans, if applicable and necessary.

Table 5. Wetland impacts and benefits from compensatory mitigation in the St. Johns Bayou Basin.

	Impacts (FCU)		Compensatory Mitigation (FCU)			Net Gain (FCU)		
Function	LGRB	LGRO	LGRB[1]	LGRO[2]	CD[3]	LGRB	LGRO	CD
Detain Flood Water	**-116**	**-397**	**+922**	**+440**	+37	**+806**	**+43**	+37
Detain Precipitation	0	-307	+1010	+625	NA	+1010	+318	NA
Cycle Nutrients	0	-344	+1147	+493	+81	+1147	+149	+81
Export Organic Carbon	-115	-319	+1115	+480	+76	+1000	+161	+76
Maintain Plant Communities	-50	-374	+1191	+513	+29	+1141	+139	+29
Provide Fish and Wildlife Habitat	0	-210	+423	+404	+29	+423	+194	+29

[1]Caluclated by adding FCU from benefits attributed to BLH restoration below an elevation of 285 and LGRB sites below the 5-year flood frequency.
[2]Calculated by adding FCU from benefits attributed to BLH LGRO sites below the 5-year flood frequency and woody riparian buffer strips.
[3]Calcualted by benefits attributed to ecologically designed borrow pits.

New Madrid Floodway

Table 6 provides a summary of impacts associated with closure of the New Madrid Floodway and operation of the pumping station, a summary of FCU changes as a result of changes to wetland subclass, and the amount of mitigation required to compensate for impacts for the tentatively selected plan. Mitigation acres are determined by dividing the impact by the corresponding FCI/acre estimated in Table 2. For example, there are 3,481 FCU impacted in the detain flood water function for the LGRB subclass. Restoring one acre of LGRB provides 0.598 FCU in the New Madrid Floodway. Therefore, 5,818 acres are required to compensate for the impact to the detain floodwater function for the LGRB subclass. Mitigation necessary to compensate for impacts to wetlands is based on the function that requires the greatest amount of mitigation. Therefore, other functions are over-compensated. The greatest amount of acreage required is highlighted in bold font. Therefore, 5,818, 57, and 215 acres of LGRB, LGRO, and CD mitigation are required to compensate for impacts to wetlands as a result of the project, respectively.

Table 6. New Madrid Floodway impacts and mitigation necessary to compensate for impacts. Mitigation assumes large tracts of LGRB.

	Losses in FCU			Gains in FCU		Mitigation (acres)		
Function	LGRB	LGRO	CD	Flats	UCD	LGRB	LGRO	CD
Detain Flood Water	-3,487	-35	-97	NA	NA	**5,828**	55	161
Detain Precipitation	-2,423	0	0	1,910	NA	2,619	0	NA
Cycle Nutrients	-2,092	0	-94	2,088	110	2,899	0	141
Export Organic Carbon	-3,558	-35	-118	NA	NA	4,929	**57**	182
Maintain Plant Communities	-2,582	-35	-124	2,183	113	3,511	52	**215**
Provide Fish and Wildlife Habitat	-1,970	-12	-89	1,616	71	3,356	26	152

Big Oak Tree State Park Restoration

A mitigation priority for the project would be to restore hydrology to Big Oak Tree State Park. Restoration would involve the construction of a gated culvert in the Mississippi River Frontline Levee to the south of the park and construction of interior channels to deliver Mississippi River surface water. Gates would be operated to allow for connectivity and inundation of the park to an elevation of 291 feet (less than a 2-year flood frequency). Although the park would likely be managed to allow for prolonged inundation after Mississippi River elevations fall, an outlet structure would also be constructed to allow the park to drain to an elevation of 288 feet. The purpose of this structure would be for water-level management to mimic a natural hydrologic regime. Compensatory mitigation benefits are attributed to a reduction in impacts[1] as well as restored hydrologic conditions[2] (Table 7). Therefore, restoring hydrology to Big Oak Tree State Park would reduce the mitigation acreage requirements by 1,615 and 83 acres, respectively for LGRB and CD.

[1] Closure of the New Madrid Floodway and pumping station would also impact the park. Impacts were already quantified for each specific alternative.
[2] Due to the existing levee system and drainage features around the park, Big Oak Tree State Park does not flood at a frequency that benefits the park's native vegetation. See McCarty (2005) for additional information regarding the park's altered hydrology and associated vegetative changes.

Table 7. Compensatory mitigation benefits from restoring hydrology to Big Oak Tree State Park.

	LGRB (976 acres)			CD (49 acres)			Mitigation (reduced acres)	
Function	Reduced Impact	Restored Hydrology	Total (FCU)	Reduced Impact	Restored Hydrology	Total (FCU)	LGRB	CD
Detain Flood Water	810	156	966	34	7	**41**	**-1,615**	-68
Detain Precipitation	976	0	976	NA	NA	NA	-1,055	NA
Cycle Nutrients	869	0	869	33	0	33	-1,204	-50
Export Organic Carbon	869	176	1,044	34	7	41	-1,447	-63
Maintain Plant Communities	927	29	957	44	4	48	-1,301	**-83**
Provide Fish and Wildlife Habitat	732	29	761	33	1	34	-1,297	-59

Big Oak Tree State Park Surrounding Land

In addition to restoring hydrology to Big Oak Tree State Park, 1,800 acres of cropland surrounding the park would also be specifically targeted for mitigation. Since these lands would also be influenced by the park's restored hydrology, compensatory mitigation would accrue at a higher rate than remaining portions of the basin (Table 8). Mitigation sites would be expected to consist of large tracts of LGRB.

Table 8. Benefits to FCU from restoring land surrounding Big Oak Tree State Park.

Function	FCI/acre	FCU (1,800 acres x FCI)
Detain Flood Water	0.598	1,076
Detain Precipitation	0.925	1,665
Cycle Nutrients	0.722	1,300
Export Organic Carbon	0.722	1,300
Maintain Plant Communities	0.759	1,366
Provide Fish and Wildlife Habitat	0.599	1,078

Remaining Fish and Wildlife Mitigation

Compensating for significant unavoidable impacts to fish and wildlife resources would also provide wetland mitigation credit. Table 9 provides the gains to wetland functions as a result of all compensatory mitigation measures. Estimates regarding mitigation values for lands that occur within the St. Johns Bayou Basin or the New Madrid Floodway assumed post-project hydrologic conditions. Since mitigation involves compensating for multiple resources, impacts to wetlands would be over-compensated (Table 10).

Table 9. Alternative 3.1 compensatory mitigation zone gains to wetlands expressed as FCU in the New Madrid Floodway.

Mitigation Zone	HGM Subclass	Acres	Detain Floodwater	Detain Precipitation	Cycle Nutrients	Export Organic Carbon	Maintain Plant Communities	Fish & Wildlife Habitat
Big Oak Tree State Park	LGRB	976	966	976	869	1044	957	761
Big Oak Tree State Park	CD	49	41	NA	33	41	48	35
Big Oak Tree State Park Surrounding Land	LGRB	1,800	1076	1665	1300	1300	1366	1078
BLH Restoration <285'	LGRB	387	232	360	279	279	286	228
BLH Restoration <5-year	LGRB	1,970	1,182	1,832	1,418	1,418	1,457	1,162
Batture Land Reforestation	LGRB	2,800	1,952	1,769	2,592	1,860	2,043	1,403
Batture Land Reforestation	LGRO	250	159	226	156	154	167	111
Ecologically Designed Borrow pits	CD[2]	30	6	N/A	20	20	17	18
Seasonally Inundated Farmland	tbd	1,286	N/C-tbd	N/C-tbd	N/C-tbd	N/C-tbd	N/C-tbd	N/C-tbd
Ten Mile Pond CA	tbd	1,917	N/C - tbd	N/C-tbd	N/C-tbd	N/C-tbd	N/C-tbd	N/C-tbd
Floodplain Lake Restoration	CD[3]	144	84	N/A	96	91	91	87

[1] Impacts are combined by summing across all agricultural lands, forested areas, and future WRP sites as well as LGRB, LGRO, CD, and UCD wetland types. Note there were impacts and gains to some categories. The value in the table is the sum of all categories. [2]Borrow pits would be designed so that half of each pit would have an average depth of less than three feet. Wetland vegetation is expected. 60 acres are proposed. Therefore, 30 acres of wetland functions would be mitigated. [3]Similar to borrow pits, it is assumed that one third of restored floodplain lakes would have an average depth of less than three feet. Wetland vegetation is expected. 432 acres of floodplain lakes are anticipated. Therefore, 144 acres of CD are expected.
N/A – not applicable, N/C – not calculated, tbd – to be determined during the development of site specific detailed mitigation plans.

Table 10. Impacts and benefits to the New Madrid Floodway.

	Losses in FCU			Compensatory Mitigation (FCU)[4]			Net Gain (FCU)		
Function	LGRB	LGRO	CD	LGRB[1]	LGRO[2]	CD[3]	LGRB	LGRO	
Detain Flood Water	**-3,487**	-35	-97	+5,408	+159	+131	**+1,921**	+62	+34
Detain Precipitation	-2,423	0	0	+6,602	+226	NA	+4,179	+226	NA
Cycle Nutrients	-2,092	0	-94	+6,458	+156	+149	+4,366	+156	+55
Export Organic Carbon	-3,558	**-35**	-118	+5,901	+154	+152	+2,343	**+36**	+34
Maintain Plant Communities	-2,582	-35	**-124**	+6,109	+167	+156	+3,527	+43	**+32**
Provide Fish and Wildlife Habitat	-1,970	-12	-89	+4,632	+111	+140	+2,662	+99	+51

[1]Caluclated by adding FCU gains associated with LGRB Big Oak Tree State Park, lands surrounding Big Oak Tree State Park, reforesting lands below 284 and the five-year frequency, and LGRB **batture** land
[2]Caluclated by adding FCU gains to 250 acres of batture land mitigation
[3]Calculated by adding FCU gains to Big Oak Tree State Park, half of the ecologically designed borrow pits, and a third of restored floodplain lakes.
[4]Note – mitigation values do not include gains attributed to a shift to different subclasses, seasonally inundated farmland, or Ten Mile Pond CA.

Terrestrial Wildlife

Habitat suitability index (HSI) values for any particular mitigation tract depend on the overall mitigation method and the species of vegetation restored on the site. For example, mitigation tracts with a high abundance of mast producing trees would generally result in high HSI values for fox squirrel. In contrast, mast producing trees do not tolerate long periods of inundation and, therefore, would not necessarily result in high HSI values for mink. Therefore, different mitigation zones provide different HSI values due to different species of vegetation restored. Habitat variables and associated HSI scores for the six mitigation zones were projected over the 50-year project life for future with- and future without-project conditions to determine appropriate compensation for unavoidable impacts to terrestrial resources. To maintain consistency, the same evaluation species for bottomland hardwood and riparian ditchbank habitats were used in the impact analysis and compensation analysis. Those species included fox squirrel, barred owl, Carolina chickadee, pileated woodpecker, and mink. Brief descriptions of the six mitigation zones used for the HEP analysis are discussed below. Additional details regarding mitigation can be found in Sections 5 and 7 of the draft EIS.

Mitigation Zone 1:

A priority would be given to Big Oak Tree State Park. This includes increasing the footprint of the park by 1,800 acres and restoring hydrology by means of a gated structure located in the Mississippi River Frontline Levee. Restoration of the 1,800 acres includes site preparation (e.g., deep disking, sub-soiling), restoration of site-specific hydrology by plugging drainage ditches, removing farm drains, and other techniques in addition to re-establishment of the Mississippi River connection, restoration of microtopography through shallow excavation of deeper areas and filling higher areas to create topographical heterogeneity, and planting of appropriate vegetation according to the site-specific hydrologic zones detailed in the Big Oak Tree State Park Natural Resource Management Plan (McCarty, 2005). Utilizing GIS, assumptions for this restoration were based on elevation data and included the following composition: 39 percent of the area planted with cypress/tupelo (hydrologic zone II), 5 percent of the area planted with cypress, pumpkin ash, and tupelo (hydrologic zone III), and 56 percent of the area planted with various oak and hickory species (hydrologic zones IV and V). A total of 1,744.20 average annual habitat units (AAHU) would be expected by the restoration of 1,800 acres surrounding Big Oak Tree State Park for a net benefit of 0.97 AAHU/acre (Table 11).

Although restoring hydrology to the park itself would result in changes to species composition and thus produce ecological benefits, no benefits were calculated for the restoration of hydrology to the park for this particular model. Benefits of restoring hydrology to the park are described in the sections that discuss the fish, wetland, and waterfowl models.

Mitigation Zone 2:

This analysis included a hypothetical 100-acre tract of land below an elevation of 285 feet. Restoration would include site preparation, restoration of hydrology, restoration of microtopography, and plantings of appropriate seedlings according to the site-specific hydrological regime. Assumptions for this restoration include the following composition: 50 percent of the area planted with cypress/tupelo seedlings, 25 percent of the area allowing for natural succession of herbaceous vegetation, and 25 percent of the area remaining in open water. A total of 72.80 AAHU would be gained through the restoration of a hypothetical 100-acre tract in Zone 2 for a net benefit of 0.73 AAHUs/acre (Table 11).

Mitigation Zone 3 and Zone 4:

This analysis included a hypothetical 100-acre tract of land within Zone 3, those lands within the maximum flood elevation (primarily lands still connected to Mississippi River or within post-project interior inundated zones), and Zone 4, those lands located above the post-project maximum flood elevation. Restoration would include site preparation, restoration of hydrology, restoration of microtopography, and planting of appropriate seedlings according to the site-specific hydrological regime. Assumptions for this restoration included the following composition: 10 percent of area allowing for natural succession of herbaceous vegetation, 30 percent of area planted with drier oak/hickory species (e.g. cherrybark oak and pignut hickory), and 60 percent of area planted with wetter oak/hickory species (e.g. overcup oak and nuttal oak). A total of 82.15 AAHU would be gained through the restoration of a hypothetical 100-acre tract in Zones 3 and 4 for a net benefit of 0.82 AAHU/acre (Table 11).

Mitigation Zone 5:

This analysis included restoration of a hypothetical 100-acre tract from cleared lands located within the batture of the Mississippi River. The assumptions for this restoration were that 100 percent of the land would revert to cottonwood/willow communities through natural succession. A total of 80.40 AAHU would be gained through the restoration of a hypothetical 100-acre tract in Zone 5 for a net benefit of 0.80 AAHU/acre (Table 11).

Mitigation Zone 6:

This analysis included a hypothetical 10-mile reach of stream which would be buffered by planting warm season grasses. Although there would be numerous benefits to terrestrial wildlife such as northern bobwhite quail and rabbit, and water quality by the establishment of warm season grasses, habitat could not be quantified by the methods utilized in this particular model. Therefore, according to this model, establishment of warm season grass buffers on area ditches would not result in a benefit.

Mitigation Zone 7:

No benefits to terrestrial wildlife are anticipated from the Ten Mile Pond CA due to the model. Although this area is intensively managed for wildlife, the model does not show any credit for farmland and moist soil units. In the event that future analysis indicates otherwise, mitigation values would be adjusted during the completion of tract specific detailed mitigation plans.

Table 11. Average annual habitat units (AAHU) gained for each mitigation zone (hypothetical 100-acre tract) in the St. Johns Bayou Basin and New Madrid Floodway project area.

Mitigation Zone	Estimated Total Benefits (AAHU)	AAHU gained/acre
Zone 1	+1744.20	+0.97
Zone 2	+72.80	+0.73
Zones 3 and 4	+82.15	+0.82
Zone 5	+80.40	+0.80
Zone 6	0	0
Zone 7	0	0

It is anticipated that mitigation would be conducted in multiple zones with a priority given to Big Oak Tree State Park. Tables 12 and 13 provide the compensatory gains to terrestrial wildlife in AAHU as compared to project impacts. As can be seen, impacts to terrestrial wildlife are over-compensated due to mitigation required for other ecological resources.

Table 12. Impacts from alternative 3.1 and gains to terrestrial wildlife in the St. Johns Bayou Basin.

Mitigation	Acres	Zone	AAHU
Impacts	-	-	-765.70
BLH Restoration < 285'	400	2	292.00
BLH Restoration < 5-Year	1,816	3	1,489.12
Riparian Buffer Strips	182	6	0.00
Ecologically Designed Borrow Pits	387	-	-
Seasonally Inundated Farmland	244	4	-
Net Gain	-	-	1,015.42

Table 13. Impacts from alternative 3.1 and gains to terrestrial wildlife in the New Madrid Floodway.

Mitigation	Acres	Zone	AAHU
Impacts	-	-	-16.88
Big Oak Tree State Park	1,000	1	970.00
Area Surrounding Big Oak Tree State Park	1,800	1	1,746.00
BLH Restoration < 285'	387	2	282.51
BLH Restoration < 5-Year	1,970	3	1,615.40
Batture Land Reforestation	3,050	5	2,440.00
Ecologically Desgined Borrow Pits	60	-	-
Seasonally Inundated Farmland	1,245	-	-
Floodplain Lake	432	-	-
Net Gain	-	-	7,037.03

Waterfowl

As stated in Section 3 and Section 4 of the draft DEIS, waterfowl is significant in the project area due to a variety of reasons. Although the tentatively selected plan provides waterfowl gains during the waterfowl season (December – January) as a result of waterfowl management, operation plans still result in impacts during the February and March time periods. Since waterfowl is considered a significant resource to the project area and Nation, mitigation is proposed to compensate for the impact to ensure that all specific time periods do not result in significant impacts to waterfowl resources according to the model.

The tentatively selected plan would result in a loss of 117,186 duck-use-days (DUD) in the St. Johns Bayou Basin. Table 14 shows DUD/acre for selected habitat types during the November, December-January, and February-March time periods used to calculate mitigation acreage. Acres of proposed mitigation were multiplied by the appropriate DUD/acre to determine DUD benefits from potential mitigation scenarios. Table 15 provides likely gains to waterfowl habitat (DUD) by compensatory mitigation features in the St. Johns Bayou Basin. The tentatively selected plan would result in a decrease of 1,856,442 DUD in the New Madrid Floodway. Table 16 provides likely gains to waterfowl habitat by compensatory mitigation features in the New Madrid Floodway.

The following assumptions were made in determining the benefits from compensatory mitigation to waterfowl resources:

- Bottomland hardwood restoration below an elevation of 285 feet would be predominantly cypress-tupelo.

- Bottomland hardwood reforestation on 1,800 acres of land surrounding Big Oak Tree State Park would be 44 percent CT and 56 percent various oaks and hickories.

- Bottomland hardwood restoration below the post-project 5-year flood frequency would be 10 percent natural revegetation and 90 percent various oaks and hickories.

- Ecologically designed borrow pits would be considered as the 0.99 three consecutive day recurrence interval.

- Ten Mile Pond Area’s moist soil units were considered as the 0.99 three consecutive day recurrence interval.

Table 14. DUD/acre for habitat type by specific time period and flood frequency.

	Cypress - Tupelo (CT)			Bottomland Hardwoods			Riverfront/Floodplain Forest			Open Water			Moist Soil Unit		
Flood Freq.	Nov	Dec-Jan	Feb-Mar	Nov	Dec-Jan	Feb-Mar	Nov	Dec-Jan	Feb-Mar	Nov	Dec-Jan	Feb-Mar	Nov	Dec-Jan	Feb-Mar
0.99	286.8	210.4	322.8	1465.6	1582.6	1255.2	406	439.8	413.8	901	652	559.4	2,022.6	1,676.2	1,375.6
0.5	143.4	105.2	161.4	732.8	791.3	627.6	203	219.9	206.9	450.5	326	279.7	1,011.3	838.1	678.8
0.2	57.4	42.1	64.6	293.1	316.5	251	81.2	88	82.8	180.2	130.4	111.9	404.5	335.2	275.1
0.1	28.7	21	32.3	146.6	158.3	125.5	40.6	44	41.4	90.1	65.2	55.9	202.3	167.6	137.6
0.04	11.5	8.4	12.9	58.6	63.3	50.2	16.2	17.6	16.6	36	26.1	22.4	80.9	67.0	55.0
0.02	5.7	4.2	6.5	29.3	31.7	25.1	8.1	8.8	8.3	18	13	11.2	40.5	33.5	27.5
0.01	2.9	2.1	3.2	14.7	15.8	12.6	4.1	4.4	4.1	9	6.5	5.6	20.2	16.8	13.8

Table 15. Impacts from alternative 2.1 and DUD gains from proposed mitigation in the St. Johns Bayou Basin.

Mitigation	Acres	November	December-January	February-March	Total
Impacts/Benefits	-	-100,891.00	978,809.00	-995,104.00	-117,186.00
DUD Losses from Agricultural Land Removed for Mitigation	2,785.37	-449,022.33	-345,234.09	-324,344.02	-1,118,600.43
Total DUD Losses	-	-549,913.33	633,574.91	-1,319,448.02	-1,235,786.43
BLH Restoration (<285')	400.00	114,720.00	84,160.00	129,120.00	328,000.00
BLH Restoration (<5-year)	1,816.00	1,390,447.40	1,494,929.40	1,196,046.10	4,081,422.90
Riparian Buffer Strips (Grass)	112.23	11,064.31	9,329.94	9,360.43	29,754.68
Riparian Buffer Strips (Woody)	70.14	19,330.80	16,067.52	16,368.96	51,767.28
Ecologically Designed Borrow Pits	387.00	348,687.00	252,324.00	216,487.80	817,498.80
Seasonally Inundated Farmland	243.64	43,562.83	41,991.35	42,789.28	128,343.46
Mitigation DUD	-	1,927,812.34	1,898,802.21	1,610,172.57	5,436,787.12
Net DUD Gain	-	1,377,899.01	2,532,377.12	290,724.55	4,201,000.69

Table 16. Impacts from alternative 3.1 and DUD gains from proposed mitigation in the New Madrid Floodway.

Mitigation	Acres	November	December-January	February-March	Total
Impacts/Benefits		57,590.00	1,376,754.00	-3,290,786.00	-1,856,442.00
DUD Losses from Agricultural Land Removed for Mitigation	7,267	-1,032,135.04	-857,152.50	-866,226.96	-2,755,514.50
Total DUD Losses		-974,545.04	519,601.50	-4,157,012.96	-4,611,956.50
Big Oak Tree State Park	1,000	732,800.00	791,300.00	627,600.00	2,151,700.00
Area Surrounding Big Oak Tree State Park	1,800	852,235.20	880,948.80	760,449.60	2,493,633.60
BLH Restoration (<285')	387	83,243.70	61,068.60	93,692.70	238,005.00
BLH Restoration (<5-year)	1,970	1,508,359.78	1,621,702.08	1,297,472.92	4,427,534.78
Batture Land Reforestation	3,050	2,125,697.50	1,765,492.50	1,797,060.00	5,688,250.00
Ecologically Designed Borrow Pits	60	54,060.00	39,120.00	33,564.00	126,744.00
Floodplain Lake	432	389,232.00	281,664.00	241,660.80	912,556.80
Seasonally Inundated Farmland	1,286	229,924.28	221,630.04	225,841.46	677,395.78
Ten Mile Pond CA	993	2,008,441.80	1,664,466.60	1,365,970.80	5,038,879.20
Mitigation DUD		7,983,994.26	7,327,392.62	6,443,312.27	21,754,699.15
Net DUD Gain		7,009,449.22	7,846,994.12	2,286,299.32	17,142,742.65

Shorebirds

As a group, shorebirds are on the decline nationally. Therefore, they are considered a significant resource. Although the loss of inundated habitat would not likely significantly impact overall shorebird populations in the region or nation, compensatory mitigation is offered to replace the potential shorebird habitat impacted by the project. Table 17 provides optimal shorebird acres impacted by project alternatives.

Table 17. Impacted area (acres) of optimally equivalent shorebird habitat during spring and fall migration periods for project alternatives.

	St. Johns Bayou Basin		New Madrid Floodway	
Alternative	Spring	Fall	Spring	Fall
Alternative 2.1/2	116.46	5.69	851.71	24.05
Alt. 3.1	116.46	5.69	614.67	23.39
Alt. 3.2	116.46	5.69	742.00	23.36
Alt. 4	116.46	5.69	323.05	0.00

One acre of optimal habitat is equivalent to one acre (sparsely vegetated) inundated at optimal depths (3.6 inches or less) for every day during the optimal time period (24 April – 23 May). Although the highest gain in shorebird value can be provided by clearing, draining, and leveling bottomland hardwoods (bottomland hardwoods do not provide suitable shorebird habitat) and make them subject to flooding during the spring, this technique would likely meet strong opposition from advocates of other ecological resources (*e.g.,* wetlands, fish). Therefore, land use changes would not be pursued to compensate for shorebird impacts. However, duration of inundation would be managed on existing agricultural areas to compensate for impacts.

Moist soil units are a common management technique utilized throughout the region and especially in the project area (*i.e.,* Ten Mile Pond Conservation Area). Moist soil units can be managed for both shorebirds and waterfowl. However, during the IEPR review, the panel indicated that the cost of management of moist soil units could be problematic for this project. Therefore, a decision was made not to pursue new moist soil management but instead rely on less intensive management techniques. However, the moist soil management units that exist in the Ten Mile Pond Conservation Area were quantified. New moist soil units can still be utilized if a future determination warrants the use during the development of tract specific plans.

As opposed to constructing new moist soil units, inundated farmland could also provide the necessary habitat to compensate for impacts.[3] Water management is a common practice on many of the agricultural lands in the project area. Management features consist of laser leveled fields, perimeter levees, water control structures, and irrigation equipment (groundwater pumps). All of these common farm features are conducive to

[3] In fact, inundated farmland is what is impacted by the project.

shorebird management and can easily be incorporated into mitigation. Likewise, many existing fields utilize this approach to manage for waterfowl habitat during waterfowl season. However, flooding does not continue during the shorebird season. Therefore, changes in overall inundation time periods can be used to compensate for shorebird impacts. Agricultural lands that are subject to floods after project construction (within the post-project 50-year floodplain) still provide shorebird habitat.[4] Therefore, agricultural lands at higher elevations in the floodplain would be pursued for compensatory mitigation.[5]

A hypothetical 100-acre tract of farmland that would no longer be subject to flooding as a result of the project was used to determine habitat gains to shorebirds from compensatory mitigation methods. Shorebird mitigation lands would be acquired in fee or through a flowage/conservation easement. Although the 100-acre field has likely been laser leveled, the field would be divided into four different zones to account for slope and depth of water. It is estimated that each zone would have an average elevation difference of 2-inches.

- Zone 1 – would be located closest to the water control structure. Therefore, depths would be greatest at this location. An assumption was that 10 percent of the 100-acre hypothetical tract would fall into this zone.
- Zone 2 – would be shallower than Zone 1 but deeper than Zone 3. An assumption was that 40 percent of the site would be located in Zone 2.
- Zone 3 – would be shallower than Zone 2 but deeper than Zone 4. An assumption was that 40 percent of the site would be located in Zone 3.
- Zone 4 – would be located on the outer fringe and consist of mudflat habitat or dry conditions. An assumption was that 10 percent of the area would be located in this zone.

The goal of shorebird management is to provide shallow water/mudflat interface. Stop logs would be inserted to capture rainfall to shallowly flood the entire site by 15 March. Each stop log would be approximately two-inches high. Groundwater/surface water pumps could be used to augment precipitation, if applicable. Water would be managed in two-inch increments over the shorebird season. Although stop logs would be used to manage water levels, water levels would still fluctuate due to precipitation events.

For the period 15 March – 2 April, the entire site would be inundated (all stops logs in place). Therefore, one 1 would be at a depth of 8 inches (suitability index (SI)=0, too deep for shorebirds), Zone 4 would likely be at a depth of less than 3 inches (SI = 1.0), and Zones 2 and 3 would fall somewhere in between (Zone 2 SI = 0.6 and Zone 3 SI = 0.8). Management would be variable and water levels would fluctuate. Therefore, during the period 15 March – 3 April the equivalent of 33 acres of optimal habitat would be expected. This is calculated as the following:

---

[4] Duration is likely reduced, thus, the lands would not provide the overall acres of optimal habitat.

[5] This translates into lands greater than an elevation of 295.7 and 290.3 in the St. Johns Bayou Basin and New Madrid Floodway, respectively.

Zone 1 = 0 acres, too deep to be available for shorebirds.
Zone 2 = 24 (40 acres * 0.6)
Zone 3 = 32 (40 acres * 0.8)
Zone 4 = 10 (10 acres * 1.0)
Sum of all zones = 66
To account for migration: 33 equivalent acres (66 acres * 0.5 SI for time period)

One stop log would be removed during the period 3 April to 23 April. Therefore, depths would decrease by two inches. The following SI values were estimated per zone: Zone 1 = 0.6, Zone 2 = 0.8, Zone 3 = 1.0, and Zone 4 = 0.4 (variable mudflat that would constantly fluctuate due to rainfall). Therefore, during the period 3 April – 23 April one could expect the equivalent of 73.8 acres. This is calculated as follows:

Zone 1 = 6 acres (10 acres * 0.6)
Zone 2 = 32 acres (40 acres * 0.8)
Zone 3 = 40 acres (40 acres * 1.0)
Zone 4 = 4 acres (10 acres * 0.4, mudflat)
Sum of all zones = 82
To account for time period = 73.8 (82 acres * 0.9 SI)

One stop log would be removed during the period 24 April – 23 May. Therefore, depths would decrease by two inches. Thus, one could expect the following SI values per zone: Zone 1 = 0.8, Zone 2 = 1.0, Zones 3 = 0.4 (variable mudflat due to precipitation), and Zone 4 would be too dry to be of value to shorebirds. The period 24 April – 23 May is the optimal time period for shorebirds (SI=1.0). The associated equivalent acreage values are presented in Table 18.

An additional stop log would be removed during the period 24 May –8 June. Therefore, depths would decrease by an additional two inches. Thus, the following SI values per zone are expected: Zone 1 = 1.0, Zone 2 = 0.4 (variable mudflat that fluctuates with precipitation), and Zones 3 and 4 would be too dry to be of significant benefit.

All stop logs would be removed by 9 June and the site would be allowed to be farmed for the remainder of the year.

Table 18. Predicted gains to shorebird habitat (hypothetical 100-acre tract) from compensatory mitigation.

	15 March – 2 April	3 April – 23 April	24 April – 23 May	24 May – June 8
Zone 1 (10% of tract)	0	6	8	10
Zone 2 (40% of tract)	24	32	40	16
Zone 3 (40% of tract)	32	40	16	0
Zone 4 (10% of tract)	10	4	0	0
Total	66	82	64	26
Time Period SI	0.5	0.9	1.0	0.9
Equivalent Optimal Acres	33	73.8	64	23.4

The following is used to calculate the annual average acres:

- There are 93 days in the spring shorebird period (15 March to 15 June).
- From Day 1 (15 March) to Day 19 (2 April) there are 627 total acres (19 days * 33 equivalent acres).
- From Day 20 (3 April) to Day 40 (23 April) there are 1,549.8 total acres (21 days * 73.8 equivalent acres)
- From Day 41 (24 April) to Day 70 (23 May) there are 1,920 total acres (30 days * 64 equivalent acres)
- From Day 71 (24 May) to Day 86 (8 June) there are 351 (15 days * 23.4 equivalent acres).
- From Day 87 (9 June) to Day 93 (15 June) there are 0 total acres.
- There are a total of 4,447.8 acre equivalent days for the year (627 + 1,549.8 + 1,920 + +351 +0).
- The average annual optimal equivalent is 47.8 acres (4,096.8/93 day spring shorebird season).

Therefore, 47.8 average equivalent acres would be expected for every 100 acres of farmland managed as above. Table 19 provides the acres required to offset impacts for each alternative managed as stated above to compensate for impacts to shorebirds as a result of the project in the St. Johns Bayou Basin and New Madrid Floodway.

Table 19. Area (acres) of managed shorebird habitat during spring and fall migration periods required to mitigate for project alternatives.

	St. Johns Bayou Basin		New Madrid Floodway	
	Spring	Fall	Spring	Fall
Alternative 2.1/2	243.64	11.89	1,781.83	50.32
Alt. 3.1	243.64	11.89	1,285.93	48.94
Alt. 3.2	243.64	11.89	1,552.31	48.86
Alt. 4	243.64	11.89	675.84	0.00

The 993 acres of moist soil units located within the Ten Mile Pond Conservation Area provide significant shorebird habitat. Utilizing the same mitigation assumptions, the shorebird habitat provided in the Ten Mile Pond Conservation Area would reduce mitigation requirements to a total of 243.6 acres and 292.9 acres in the St. Johns Bayou and New Madrid Floodway, respectively.

It is anticipated that a portion of the spring shorebird compensation sites would also be used to provide the necessary shorebird habitat during the fall migration. Some agricultural commodities such as rice require inundation during different periods of the year as well as water management. Although soybeans would require planting past 8 June (sub-optimal return), commodities such as rice may be complementary to shorebird management if periods of inundation for rice overlap periods that are required for shorebirds, as long as the rice has not grown to a point that it becomes un-desirable for shorebirds. Management options that complement both rice production as well as shorebird management would be investigated during the completion of site-specific mitigation plans. Compensatory mitigation benefits/needs would be adjusted accordingly.

The IEPR panel provided the following comment concerning potential mitigation for other ecological resources and wetlands:

"The panel understands that the project area is highly modified from its historic conditions. These conditions notwithstanding, the goal of the mitigation plan is to compensate for losses in ecological function measured by comparing current without-project conditions to future with-project conditions. Importantly, this mitigation becomes part of the project and, therefore, all wildlife habitat losses that would result from the project, including those directly attributable to mitigation activities for other resource types, should be mitigated. The panel will concur if USACE states that all wildlife habitat impacts, including those resulting from mitigation of other project impacts, will be fully mitigated."

USACE position as related to mitigation for shorebirds is as follows:

a. Mitigation is a means to compensate for unavoidable impacts over the project life. Mitigation is not based on any one species or assemblage of a type of species such as shorebirds. It is based on unavoidable functional impacts from an ecosystem and adequately replacing those unavoidable ecosystem functional losses. Habitat units reflect an overall functional value, based on a collection of different species, assemblages, and uses.

b. Shorebirds inhabit the area more frequently now only because the bottomland hardwoods that were on the land have been cleared due to agricultural activity. Had the clearing not occurred, the birds would not be present in greater numbers than seen historically. Mitigation is a means to attempt to restore/replace/create natural habitat that occurred prior to alteration. Therefore, there would be a significant amount of bottomland hardwood/riverfront forest mitigation.

c. The mitigation plan would restore habitat to a historic condition. Similar to the way the shorebirds have relocated/exploited the farmland in the project area, the shorebirds would likely relocate to other agricultural fields, sand bars, and marshlands in the Mississippi River Valley and elsewhere.

d. The loss of additional farmland through compensatory mitigation would not result in a significant impact to shorebirds due to the abundance of flooded farmland post-project.

The issue regarding conflicting resources for ecosystem restoration projects or compensatory mitigation is not uncommon. Restoring benefits for one resource usually comes at a cost to another. Sparks (1995) recognized this problem of impacts to different species and groups of animals and their human advocates. Sparks further stated that the goal of ecosystem management[6] should be to maintain and recover the biological integrity of the ecosystem. Biological integrity was defined as "the capability of supporting and maintaining a balanced, integrated adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of a <u>natural habitat of the region</u> (emphasis added)" (Angermeier and Karr 1994, Sparks 1995).

Leveled cleared farmland does not fit the definition of "natural habitat of the region." Proposed mitigation for other resources would restore the natural habitat of the region. Additional mitigation for shorebird habitat would not be required, as any needed mitigation would be provided through compensatory actions for impacts to waterfowl, fish, wetlands, and terrestrial wildlife.

Fish

Alternative 3.1 would result in an impact of 386.6, 441.3, and 245.3 AAHU in the St. Johns Bayou Basin for the early, mid, and late season spawning and rearing periods, respectively. Alternative 3.1 would result in an impact of 1,729.5, 2,061.1, and 1,165.8 AAHU in the New Madrid Floodway during the early, mid, and late fish spawning and rearing seasons, respectively.

A consistent methodology was applied to determine potential benefits to fish spawning and rearing habitat as was used to determine project-induced impacts. Benefits from compensatory mitigation to fish spawning and rearing habitat can basically occur in three ways. The first is the conversion of one habitat type to another type of habitat that is of higher value to fishes (*i.e.*, HSI value). An example is converting agricultural areas (HSI = 0.2) to bottomland hardwoods (HSI = 1.0). Another method is to restore river connectivity. For example, restoring hydrology to Big Oak Tree State Park without any change to overall land use would result in gains to spawning and rearing habitat. The third method is to increase duration of flooding (*i.e.*, increase in average daily flooded acres (ADFA)).

[6] Compensatory mitigation for this particular case.

The habitat value for newly planted bottomland hardwood sites would not reach full habitat value (HSI = 1.0) for a period of time. Therefore, a transition period would be necessary. A reforested bottomland hardwood would take many years of growth to reach maximum benefit for floodplain fishes, although some benefits would potentially accrue prior to maturity. A factor considered in determining the length of transition was the cover a forest would provide (trunk, leaves, and twigs). Transition periods were separated into two different types for bottomland hardwood/riverfront forest restoration (*i.e.,* fast growing and slow growing).

Black willow and cottonwood are representative fast growing species. A length of 10 years was used to achieve maximum benefit for floodplain fishes that would be planted in fast growing species on agricultural areas.

Bald cypress and red oaks are representative slow growing species. A length of 20 years was used to achieve maximum benefit for floodplain fishes that would be planted in slow growing species on agricultural areas. Many slow growing varieties of trees are more beneficial to terrestrial wildlife and waterfowl due to the food they provide (*i.e.*, acorns). However, this is not the case for fish spawning and rearing habitat. Both slow and fast growing varieties provide equal habitat value at maturity.

Similar to existing project lands, mitigation lands may not be flooded continuously during the spawning and rearing season. In addition to transition periods, the ADFA that any particular area would provide must be calculated. Hydraulic and hydrology (H+H) analysis was conducted to determine the percent of ADFA that would be available for each one-foot contour for associated mitigation credit for impacts that would result from the implementation of the tentatively selected plan (Tables 20 and 21).

Table 20. Alternative 3.1 ADFA percent according to elevation, St. Johns Bayou Basin.

St. Johns Authorized Elevation	Early Season % ADFA	Mid Season % ADFA	Late Season % ADFA
280	38.4	36.9	16.9
281	34.9	32.9	14.7
282	30.5	29.8	12.8
283	27.4	27.6	10.8
284	24.7	25.3	9.5
285	21.8	22.4	7.5
286	18.4	19.4	6.3
287	16.5	17.3	5.1
288	14.1	14.8	4.4
289	12.3	11.4	3.9
290	8.5	8.0	3.2
291	4.1	5.2	2.3
292	2.1	4.0	1.7
293	1.8	3.4	1.0

Table 21. Alternative 3.1 ADFA percent according to elevation, New Madrid Floodway.

NMF Alt. 3.1 Elevation	Early Season % ADFA	Mid Season % ADFA	Late Season % ADFA
280	54.7	51.3	14.8
281	50.5	47.7	13.5
282	45.6	44.2	12.1
283	41.7	34.3	6.2
284	38.6	21.6	0.7
285	34.0	18.4	0.0
286	27.4	14.7	0.0
287	19.4	9.1	0.0
288	4.5	1.4	0.0
289	0.9	0.1	0.0

Impacts and mitigation were enumerated as AAHU, and the difference between pre- and post-project AAHUs were defined as the impact of the project. Therefore, mitigation would be required to compensate for reduced AAHU, which would depend on the habitat value (i.e. HSI value) of the techniques used in the mitigation plan. AAHU, not ADFA, were the key unit used to determine mitigation requirements. Benefits to fish rearing habitat from mitigation measures would be calculated by the following equations:

Habitat Gains = AAHU per tract with mitigation – AAHU per tract without mitigation

Where AAHU are averaged over a 50-year project life, and multiplied by a fish access coefficient

AAHU = Cumulative HUs/50 years x fish access coefficient, where fish access coefficient = 0.73

and Cumulative HU are calculated by,

$$\text{Cumulative HU} = \sum_{n=1}^{2} \left[(T_{n+1} - T_n) * (\text{ADFA}) * \left[\frac{\text{HSI}_n + \text{HSI}_{n+1}}{2} \right] \right]$$

Where:
T_n = first target year of time interval
T_{n+1} = last target year of time interval
ADFA = acres * percent ADFA according to elevation
HSI_n = HSI at beginning of time interval
HSI_{n+1} = HSI at end of time interval

Big Oak Tree State Park and 1,800 Surrounding Acres (Mitigation Zone 1)

Although it would take an approximate 5-year flood under existing conditions to inundate Big Oak Tree State Park, the tentatively selected plan would remove Big Oak Tree State Park from the five-year floodplain. Therefore, under with project conditions, Big Oak Tree State Park would not provide any fish spawning and rearing habitat. These impacts are included in the previous impact calculations.

ADFA was calculated for the park and the surrounding 1,800 acres of farmland by restoring Mississippi River hydrology to the park and surrounding areas. Based on H+H analysis, restoring Mississippi River hydrology to the park and surrounding 1,800 acres of cropland would provide 1,490.8, 1,450.6, and 941.4 ADFA for the early, mid, and late fish spawning and rearing seasons, respectively. An assumption was that slow growing trees would be planted on the adjacent cleared areas. Therefore, HSI would increase from 0.2 to 1.0 over a 20-year transition.

Likewise, fish access through the culverts would likely take place because of the following reasons:

- Water would be flowing into the basin during many open-gate periods, so excessive water velocity would not be an impediment to movement during these periods. In addition, those fishes that were spawned or are rearing in the basin could be easily transported back to the river when water direction through the culvert is reversed during falling Mississippi River stages.
- There would be no outlet or inlet drop in elevation from the connecting channels.
- Culvert slope would be nearly level.
- A relatively short distance would be required for fish to access the backwater.
- Water depth would be equal to the river stage up to the 5-foot height of the culvert, which would be more than adequate for swimming fishes.
- The utilization of similar sized culverts elsewhere to promote fish passage.
- Documented fish passage in the St. Johns Bayou Basin.

Therefore, fish access was assumed to be equal to that of the New Madrid Floodway (0.73).

The following steps were used to determine mitigation benefits for the early season period:

BLH Transition: 17,889.6 HU = (20 years) * (1,490.8) * [(0.2+1.0)/2]
BLH for remainder of project life: = 44,724 HU (30 years) * (1,490.8) * [1.0]
Cumulative HU: 62,613.6 (17,889.6 HU + 44,724 HU)
AAHU: 1,252.3 (62,613.6 cumulative HU/50 years)
Fish Access Coefficient: 914.0 AAHU (1,252.3 * 0.73)

The following steps were used to determine mitigation benefits for the mid season period:

BLH Transition: 17,407.2 HU = (20 years) * (1450.6) * [(0.2+1.0)/2]
BLH for remainder of project life: = 43,518 HU (30 years) * (1,450.6) * [1.0]
Cumulative HU: 60,925.2 (17,407.2 HU + 43,518 HU)
AAHU: 1,218.5 (60,925.2 cumulative HU/50 years)
Fish Access Coefficient: 889.5 (1,218.5 * 0.73)

The following steps were used to determine mitigation benefits for the late season period:

BLH Transition: 11,296.8 HU = (20 years) * (941.4) * [(0.2+1.0)/2]
BLH for remainder of project life: = 28,242 HU (30 years) * (941.4) * [1.0]
Cumulative HU: 39,538.8 (11,296.8 HU + 28,242 HU)
AAHU: 790.8 (39,538.8 cumulative HU/50 years)
Fish Access Coefficient: 577.3 (790.8 * 0.73)

AAHUs with compensatory mitigation benefits for restoring Big Oak Tree State Park in the New Madrid Floodway were assumed to mitigate impacts. These benefits could also be used to compensate for impacts to the St. Johns Bayou Basin, if warranted. Any changes would be described in the site-specific detailed mitigation plan.

Vegetated Wetland Restoration

Historically, the lower Mississippi River Valley was comprised of bottomland hardwood forests that frequently flooded during the spring. The aquatic communities that evolved under these conditions became pre-adapted to flooding, utilizing the structurally complex habitats formed by woody debris from surrounding trees and herbaceous vegetation that would form in ridge-swale topography for reproduction, feeding, and avoiding predators. Therefore, one of the primary mitigation tools would be to convert agricultural lands back to forested habitat and or herbaceous wetlands.

Lands Less Than an Elevation 285 (Mitigation Zone 2)

Consistent with the determination of impacts, compensatory mitigation benefits were a function of underlying land use (HSI values), flood frequency (within the 2-year or 5-year floodplain), and flood duration and area extent (ADFA). Agricultural lands that would be reforested at the lowest elevations in the St. Johns Bayou Basin and New Madrid Floodway are of greater value (per unit area) than those reforested at higher elevations. Therefore, secondary priority[7] would be given to lands at the lowest elevations. There are approximately 1,654 (57 percent of total area) and 1,547 (50 percent of total area) acres of agricultural lands at or below an elevation of 285 feet in the St. Johns Bayou Basin and New Madrid Floodway, respectively. An assumption was that 25 percent of these lands would be acquired for compensatory mitigation.[8] Another assumption was that reforesting would consist of slow growing species (20-year transition period).

<u>St. Johns Bayou Basin</u>

The hypothetical 400 acres of farmland would provide a minimum of 12.7, 13.1, and 4.6 AAHU for the early, mid, and late season periods, respectively (400 acres * applicable ADFA/ percentage from Table 20 ***** 0.2 HSI *0.73 Access).

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from reforesting 400 acres[9] (approximately 25 percent of available lands) of agricultural lands below an elevation of 285 feet in the early-season period:

BLH Transition: 1,046.4 HU = (20 years) * (87.2) * [(0.2+1.0)/2]
BLH for remainder of project life: = 2,616 HU = (30 years) * (87.2) * [1.0]

[7] Primary priority will be to lands surrounding Big Oak Tree State Park.
[8] Lands at the lowest elevations in both basins would still remain subject to flooding due to their respective elevations. Therefore, it is assumed that these lands would be made available from willing sellers.
[9] 400 acres translates into 87.2 ADFA (see Table 20 and the corresponding value of 21.8%). This estimate assumes all lands would be at an elevation of 285 feet. This was considered a conservative estimate since some lands would probably be located at elevations below 285 feet which would result in greater mitigation value.

Cumulative HU: 3662.4 (1,046.4 HU + 2,616 HU)
Early Season AAHU: 73.2 (3,662.4 cumulative HU/50 years)
Fish Access Coefficient: 53.4 (73.2 AAHU * 0.73)
Mitigation Benefit = 40.7 AAHU (53.4 with mitigation AAHU – 12.7 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from reforesting 400 acres[10] (approximately 25 percent of available lands) of agricultural lands below an elevation of 285 feet in the mid-season period:

BLH Transition: 1,075.2 HU = (20 years) * (89.6) * [(0.2+1.0)/2]
BLH for remainder of project life: = 2,688 HU (30 years) * (89.6) * [1.0]
Cumulative HU: 3,763.2 (1,075.2 HU + 2,688 HU)
Mid-Season AAHU: 75.3 (3,763.2 cumulative HU/50 years)
Fish Access Coefficient: 55.0 (75.3 AAHU * 0.73)
Mitigation Benefit = 41.9 AAHU (55.0 with mitigation AAHU – 13.1 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from reforesting 400 acres[11] (approximately 25 percent of available lands) of agricultural lands below an elevation of 285 feet in the late-season period:

BLH Transition: 379.2 HU = (20 years) * (31.6) * [(0.2+1.0)/2]
BLH for remainder of project life: = 948 HU (30 years) * (31.6) * [1.0]
Cumulative HU: 1,327.2 (379.2 HU + 948 HU)
Late Season AAHU: 27.4 (1,372.2 cumulative HU/50 years)
Fish Access Coefficient: 20.0 AAHU (27.4 AAHU * 0.73)
Mitigation Benefit = 15.4 AAHU (20.0 with mitigation AAHU – 4.6 without mitigation AAHU)

New Madrid Floodway

The hypothetical 387 acres of farmland would provide 19.3, 10.5, and 0 AAHUs for the early, mid and late season fish spawning and rearing period, respectively (387 acres * applicable ADFA/percentage from Table 21 ***** 0.2 HSI * 0.73 fish access coefficient).

The following steps were used to determine compensatory mitigation benefits in the New Madrid Floodway from reforesting 387 acres[12] (approximately 25 percent of available lands) agricultural lands below an elevation of 285 feet in the early-season period:

[10] 400 acres translates into 89.6 ADFA (see Table 20 and the corresponding value of 22.4%). This estimate assumes all lands would be at an elevation of 285 feet. This was considered a conservative estimate since some lands would probably be located at elevations below 285 feet which would result in greater mitigation value.
[11] 400 acres translates into 31.6 ADFA (see Table 20 and the corresponding value of 7.5%). This estimate assumes all lands would be at an elevation of 285 feet. This was considered a conservative estimate since some lands would probably be located at elevations below 285 feet which would result in greater mitigation value.

BLH Transition: 1,584 HU = (20 years) * (132) * [(0.2+1.0)/2]
BLH for remainder of project life: = 3,960 HU (30 years) * (132) * [1.0]
Cumulative HU: 5,544 (1,584 HU + 3,960 HU)
Early Season AAHU: 110.9 (5,544 cumulative HU/50 years)
Fish Access Coefficient: 81.0 (110.9 * 0.73)
Mitigation Benefit = 61.7 AAHU (81.0 with mitigation AAHU – 19.3 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the New Madrid Floodway from reforesting 387 acres[13] (approximately 25 percent of available farmlands) of agricultural lands below an elevation of 285 feet in the mid-season period:

BLH Transition: 859.2 HU = (20 years) * (71.6) * [(0.2+1.0)/2]
BLH for remainder of project life: = 2,148 HU (30 years) * (71.6) * [1.0]
Cumulative HU: 3,007.2 (859.2 HU + 2,148 HU)
Mid-Season AAHU: 60.1 (3,007.2 cumulative HU/50 years)
Fish Access Coefficient: 81.0 (110.9 * 0.73)
Mitigation Benefit = 70.5 AAHU (81.0 with mitigation AAHU – 10.5 without mitigation AAHU)

There are no compensatory mitigation benefits from reforesting lands below an elevation of 285 in the late-season period because the ADFA percent is 0 (see Table 21).

Lands Within the Post Project 5-year Floodplain (Mitigation Zone 3)

Alternative 3.1 would lower the 5-year floodplain to an elevation of 292.6 and 288.7 in the St. Johns Bayou Basin and the New Madrid Floodway, respectively. Lands must be within the post-project 5-year floodplain to be of value to fish. Due to the weighting factor conducted for impact analysis, agricultural lands do not provide any fish spawning and rearing value at the 5-year frequency. As can be seen in Table 20 and 21**,** site specific areas need to be known to determine the amount of ADFA per acre of habitat. Lands at lower elevations that flood more frequently and have longer durations provide more value to fish per unit area.

<u>St. Johns Bayou Basin</u>

A hypothetical 100-acre tract of land located at an elevation of 288 was used to estimate mitigation. An assumption was that slow growing species of trees would be planted on the mitigation tract. The hypothetical 100-acre tract of land would provide 2.1, 2.2, and

---

[12] 387 acres translates into 132 ADFA (see Table 21 and the corresponding value of 34.1%). This estimate assumes all lands would be at an elevation of 285 feet. This was considered a conservative estimate since some lands would probably be located at elevations below 285 feet which would result in greater mitigation value.

[13] 387 acres translates into 71.6 ADFA (see Table 21 and the corresponding value of 18.5%). This estimate assumes all lands would be at an elevation of 285 feet. This was considered a conservative estimate since some lands would probably be located at elevations below 285 feet which would result in greater mitigation value.

0.6 AAHUs for the early, mid, and late fish spawning and rearing periods, respectively (100 * applicable ADFA percentage from Table 20 ***** 0.2 HSI * 0.73 Access).

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from reforesting a hypothetical 100 acres[14] of agricultural lands at an elevation of 288 feet in the early season period:

BLH Transition: 169.2 HU = (20 years) * (14.1) * [(0.2+1.0)/2]
BLH for remainder of project life: = 423 HU (30 years) * (14.1) * [1.0]
Cumulative HU: 592.2 (169.2 HU + 423 HU)
Early Season AAHU: 11.8 (592.2 cumulative HU/50 years)
Fish Access Coefficient: 8.6 AAHU (11.8 AAHU * 0.73 Access)
Mitigation Benefit = 6.7 AAHU (8.6 with mitigation AAHU – 2.1 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from reforesting a hypothetical 100 acres[15] of agricultural lands at an elevation of 288 feet in the mid season period:

BLH Transition: 177.6 HU = (20 years) * (14.8) * [(0.2+1.0)/2]
BLH for remainder of project life: = 444 HU (30 years) * (14.8) * [1.0]
Cumulative HU: 621.6 (177.6 HU + 444 HU)
Mid-Season AAHU: 12.4 (621.6 cumulative HU/50 years)
Fish Access Coefficient : 9.1 AAHU (12.4 AAHU * 0.73 Access)
Mitigation Benefit = 6.9 AAHU (9.1 with mitigation AAHU – 2.2 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from reforesting a hypothetical 100 acres[16] of agricultural lands at an elevation of 288 feet in the late season period:

BLH Transition: 52.8 HU = (20 years) * (4.4) * [(0.2+1.0)/2]
BLH for remainder of project life: = 132 HU (30 years) * (4.4) * [1.0]
Cumulative HU: 184.8 (52.8 HU + 132 HU)
Late Season AAHU: 3.7 (184.8 cumulative HU/50 years)
Fish Access Coefficient: 2.7 AAHU (3.7 AAHU * 0.73)
Mitigation Benefit = 2.1 AAHU (2.7 with mitigation AAHU – 0.6 without mitigation AAHU)

[14] 100 acres translates into 14.1 ADFA (see Table 20 and the corresponding value of 14.1%). This estimate assumes all lands would be at an elevation of 288 feet.
[15] 100 acres translates into 14.8 ADFA (see Table 20 and the corresponding value of 14.8%). This estimate assumes all lands would be at an elevation of 288 feet.
[16] 100 acres translates into 4.4 ADFA (see Table 20 and the corresponding value of 4.4%). This estimate assumes all lands would be at an elevation of 288 feet.

<u>New Madrid Floodway</u>

A hypothetical 100-acre tract of farmland located at an elevation of 287 was used to estimate compensatory mitigation in the New Madrid Floodway. An assumption was that slow growing species of trees would be planted on the mitigation tract. The hypothetical 100-acre tract of land would provide 2.8, 1.3, and 0.0 AAHUs for the early, mid, and late fish spawning and rearing periods, respectively (100 * applicable ADFA percentage from Table 21 ***** 0.2 HSI * 0.73 access).

The following steps were used to determine compensatory mitigation benefits in the New Madrid Floodway from reforesting a hypothetical 100 acres[17] of agricultural lands at an elevation of 287 feet in the early season period:

> BLH Transition: 232.8 HU = (20 years) * (19.4) * [(0.2+1.0)/2]
> BLH for remainder of project life: = 582 HU = (30 years) * (19.4) * [1.0]
> Cumulative HU: 814.8 (232.8 HU + 582 HU)
> Early Season AAHU: 16.3 (814.8 cumulative HU/50 years)
> Fish Access Coefficient: 11.9 (16.3 * 0.73)
> **Mitigation Benefit = 9.1 AAHU** (11.9 with mitigation AAHU – 2.8 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the New Madrid Floodway from reforesting a hypothetical 100 acres[18] of agricultural lands at an elevation of 287 feet in the mid-season period:

> BLH Transition: 110.4 HU = (20 years) * (9.2) * [(0.2+1.0)/2]
> BLH for remainder of project life: = 276 HU (30 years) * (9.2) * [1.0]
> Cumulative HU: 386.4 (110.4 HU + 276 HU)
> Early Season AAHU: 7.7 (386.4 cumulative HU/50 years)
> Fish Access Coefficient: 5.6 (7.7 * 0.73)
> **Mitigation Benefit = 4.3 AAHU** (5.6 with mitigation AAHU **–** 1.3 without mitigation AAHU)

There are no compensatory mitigation benefits from reforesting lands below an elevation of 287 in the late season period because the ADFA percent is 0 (see Table 21).

Batture Land (Mitigation Zone 5)

The Phase 2 IEPR panel stated that batture land mitigation is suitable to compensate for fish impacts if access were determined to be an issue. No access impacts would be

---

[17] 100 acres translates into 19.4 ADFA (see Table 21 and the corresponding value of 19.4%). This estimate assumes all lands would be at an elevation of 288. Therefore, this is a conservative estimate since some lands would be below this elevation so ADFA would likely be greater.
[18] 100 acres translates into 9.2 ADFA (see Table 21 and the corresponding value of 9.2%). This estimate assumes all lands would be at an elevation of 287. Therefore, this is a conservative estimate since some lands would be below this elevation so ADFA would likely be greater.

associated with the St. Johns Bayou Basin portion of the project, because the gate was previously constructed. Therefore, a consistent fish access coefficient (0.73) was applied to pre-project conditions as well as post-project conditions. However, another situation would occur in the New Madrid Floodway. Pre-project conditions do not include a fish access coefficient in habitat calculations. Remaining habitat value after construction of the preliminary recommended plan (within the post-project 2-year floodplain for sub-optimal habitat and within the post-project 5-year floodplain for optimal habitat) was reduced by the fish access coefficient (0.73). No associated fish access issues would occur with batture land mitigation. Therefore, no reduction in value was calculated.

Many areas within the batture lands offer suitable habitat for spawning and rearing fish. The approximate 2-year floodplain located at river mile 900 (tip of Donaldson Point) is approximately 297.6 feet. Based on H+H analysis, approximately 29 percent, 29 percent, and 13 percent ADFA per acre would result for the early, mid, and late season, respectively. An assumption was that agricultural areas would be allowed to regenerate naturally or would be planted in early successional varieties. Therefore, a 10-year transition would be expected for the HSI value to increase from 0.2 (agriculture HSI) to 1.0 (bottomland hardwood HSI).

A hypothetical 100-acre plot of farmland was used on Donaldson Point. The 100 acres of farmland provide 5.8 AAHU (29 ADFA * 0.2 HSI), 5.8 AAHU (29 ADFA * 0.2 HSI), and 0.03 AAHU (13 ADFA * 0.2 HSI) under the pre-mitigation scenario for the early, mid, and late seasons, respectively. Fish access is not constrained in the batture.

Mitigation involves natural regeneration of black willow and cottonwood. Therefore, HSI increases from 0.2 to 1.0 over a 10-year transition. The following steps are used to determine with mitigation benefits during the early and mid seasons:

> BLH transition period: 186 HU = (10 years) * (31 ADFA) * [0.2 + 1.0)/2]
> BLH for remainder of project life: = 1,240 HU (40 years) * (31 ADFA) * (1.0)
> Cumulative HU: 1,426 = (186 HU + 1,240 HU)
> AAHU = 28.52 (1,426 cumulative HU/50 years)
> **Mitigation Benefit = 22.7 AAHU** (28.5 AAHU with mitigation) – 5.8 AAHU (without mitigation)

Therefore, 22.7 AAHU would be provided by reforesting 100 acres of farmland within the batture land for the early- and mid-season spawning and rearing period.

Riparian Buffer Strips (Mitigation Zone 6)

The Missouri Stream Mitigation Method (MSMM) is being used to calculate impacts from channel modification to reaches in the St. Johns Bayou Basin as well as the associated mitigation credits from riparian buffer strip establishment (see DEIS Section 4.11). The proposed buffer strips would consist of woody vegetation establishment along one bank and warm season grass establishment on the opposite bank. In addition to compensating for impacts to channel modification, buffer strips would also provide spawning and rearing habitat for fisheries resources (depending on the elevation of the buffer strips). A 50-foot buffer along 11.9 miles (93 acres) of St. Johns and Setback Levee Ditches would be established for Alternative 3.1. For planning purposes, it was assumed that half of the 93 acres (46.5 acres) would be located at or below an elevation of 288 feet. It was also assumed that native warm season grasses would provide an HSI value of 0.5 (fallow) and woody vegetation would provide an HSI value of 1.0. Therefore, there would also be a net increase to spawning and rearing habitat.

The 46.5 acres of farmland provides 0.96, 1.0, and 0.3 AAHU for the early, mid, and late fish spawning and rearing period, respectively (46.5 * applicable ADFA/percentage from Table 20 ***** 0.2 HSI * 0.73 Fish Access Coefficient). The transition to warm season grasses was assumed to take one year, while the transition to BLH would take 15 years (MSMM).

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from planting a buffer on 46.5 acres[19] of agricultural lands at an elevation of 288 feet in the early-season period:

> BLH Transition: 62.1 HU = (15 years) * 6.9 * [(0.2+1.0)/2]
> Grass Transition: 2.4 HU = (1 year) * (6.9) * [(0.2+ 0.5)/2]
> BLH buffer for remainder of project life: 241.5 HU = (35 years) * (6.9) * [1.0]
> Grass buffer for remainder of project life: 169.1 HU = (49 years) * 6.9 * 0.5
> Cumulative HU: 475.1 (62.1 HU + 2.4 HU +241.5 HU + 169.1 HU)
> Early Season AAHU: 9.5 (475.1 cumulative HU/50 years)
> Fish Access Coefficient : 6.9 (9.5 AAHU * 0.73)
> **Mitigation Benefit = 5.9 AAHU (**6.9 with mitigation AAHU **–** 0.96 without mitigation AAHU)

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from planting a buffer on 46.5 acres[20] of agricultural lands at an elevation of 288 feet in the mid-season period:

> BLH Transition: 59.4 HU = (15 years) * 6.6 * [(0.2+1.0)/2]
> Grass Transition: 2.3 HU = (1 year) * (6.6) * [(0.2+ 0.5)/2]
> BLH buffer for remainder of project life: 231.0 HU = (35 years) * 6.6 *[1.0]
> Grass buffer for remainder of project life: 161.7 HU = (49 years) * (6.6) * [0.5]
> Cumulative HU: 454.4 (59.4 HU + 2.3 HU + 231.0 HU + 161.7 HU)
> Mid-Season AAHU: 9.1 (454.4 cumulative HU/50 years)
> Fish Access Coefficient : 6.6 AAHU (9.1 AAHU * 0.73)
> **Mitigation Benefit = 5.6 AAHU (**6.6 with mitigation AAHU **–** 1.0 without mitigation AAHU)

[19] 46.5 acres translates into 6.9 ADFA (see Table 20 and the corresponding value of 14.8%). This estimate assumes all lands would be at an elevation of 288.
[20] 46.5 acres translates into 6.6 ADFA (see Table 20 and the corresponding value of 14.1%). This estimate assumes all lands would be at an elevation of 288.

The following steps were used to determine compensatory mitigation benefits in the St. Johns Bayou Basin from planting a buffer on 46.5 acres[21] of agricultural lands at an elevation of 288 feet in the late-season period:

> BLH Transition: 18.9 HU = (15 years) * 2.1 * [(0.2+1.0)/2]
> Grass Transition: 0.7 HU = (1 year) * (2.1) * [(0.2+ 0.5)/2]
> BLH buffer for remainder of project life: 73.5 HU = (35 years) * 2.1 * [1.0]
> Grass buffer for remainder of project life: 51.5 HU = (49 years) * (2.1) * [0.5]
> Cumulative HU: 144.6 (18.9 HU + 0.7 HU + 73.5 HU + 51.5 HU)
> Mid-Season AAHU: 2.9 (144.6 cumulative HU/50 years)
> Fish Access Coefficient: 2.1 AAHU (2.9 AAHU * 0.73)
> **Mitigation Benefit = 1.8 AAHU (**2.1 with mitigation AAHU – 0.3 without mitigation AAHU)

Ecologically Designed Borrow Pits

Ecologically designed borrow pits are an excellent measure to compensate for impacts associated with the project (J. Jackson, personal communication, Battelle, 2010). Compensatory mitigation benefits provided from borrow pit construction compensates for project impacts including impacts to waterbodies and inundated floodplain habitat. Approximately 387 and 60 acres of borrow pits would be constructed for the project in the St. Johns Bayou Basin and New Madrid Floodway, respectively. Borrow pits and waterbodies provide high quality spawning and rearing habitat for a variety of species (Baker *et al.*, 1991). When access is available during flood events in the project area (*i.e.,* within the 5-year floodplain), adult fish would be attracted to the borrow pits because of deep water and abundant forage fishes that often concentrate in them after flood waters recede. In addition, to maximize the benefit, each pit would be located above the post project 2-year floodplain (agriculture HSI = 0 above the two year) but within the 5-year floodplain (Mitigation Zone 3). Many of these adult fish would spawn in shallow, structurally complex littoral areas of the borrow pits, since plankton densities are usually high in waterbodies; once eggs hatched, larval fish would have an abundant food source. Since high densities of fish are characteristic of waterbodies/borrow pits, many of these individuals would eventually be transported or would move into the Mississippi River during subsequent floods.

The ecological design of borrow pits would follow the guidelines established by Aggus and Ploskey (1986), which recommends some areas of deep water (*e.g.,* 6-10 feet deep), a sinuous shoreline, establishment of islands, and a variable bottom topography. Average depth of each pit would influence fish assemblages. Shallow areas are suitable for characteristic wetland species such as fliers, pirate perch, taillight shiners, and young-of-year fishes. Deeper areas are more conducive for sport and commercial species. Therefore, construction of each pit would recognize the importance of providing shallow water and deep water to benefit the maximum number of species and life stages. However, existing oxbow lakes that are protected from flooding by the river levees and

---

[21] 46.5 acres translates into 2.1 ADFA (see Table 20) and the corresponding value of 4.4%). This estimate assumes all lands would be at an elevation of 288 feet.

are partly or entirely surrounded by agricultural lands typically experience changed drainage patterns, increased turbidity, and accelerated sedimentation. Cooper and McHenry (1989) reported sediment accumulations in Moon Lake, MS and predicted that in 50 years such deposition would reduce the area of the lake by 3–7 percent, progressing from the two shallow ends. To reduce the possibility of sedimentation in constructed borrow pits, USACE proposes that a 25-foot bottomland hardwood buffer be established around each pit. Schoonover et al. (2005) reported that a 22-foot forest buffer strip reduced sediment loads from agricultural areas to adjacent waters by 86 percent. Therefore, extensive sedimentation is not anticipated.

The ecological design of borrow pits would be as follows:

- 50 percent of each pit would have an average depth of at least six feet to provide habitat for species that are commercially and recreationally valuable.
- 50 percent of each pit would have an average depth of at least three feet to provide habitat for fishes that require shallower habitat.
- All borrow pits would be constructed within the post-project 5-year floodplain. Therefore, they would be considered as fish spawning and rearing habitat benefits.
- Islands and diverse topography would be created.
- Aquatic vegetation would propagate naturally in shallow areas.
- Bottomland hardwoods would be restored around each pit to provide a buffer.
- Structure (trees, limbs, etc.) would be placed within newly constructed pits when practical. Structure would be obtained from cleared sites necessary for other construction. No vegetation would be cleared for the sole purpose of obtaining structure.
- Connection to existing borrow pits would be made to the extent practical.
- Public access would be made available to the extent practical.

Material necessary for the Setback Levee grade raise would be provided from construction of ecologically designed borrow pits (387 acres) located in the lower portion of the St. Johns Bayou Basin. The material necessary for the closure levee and Frontline Levee raise would be provided from the construction of ecological designed borrow pits located in the lower portion of the New Madrid Floodway. In addition, to maximize the benefit, each pit would be located above the post project 2-year floodplain (agriculture HSI = 0 above the two year) but within the 5-year floodplain (Mitigation Zone 3). HSI would increase from zero to 1.0. A five-year transition period is also assumed to obtain an HSI value of 1.0. Therefore, AAHU is calculated as follows:

St. Johns Bayou Basin

Borrow Pit Transition: 967.5 HU = (5 year) * (387) * [(0.0+ 1)/2]
Borrow Pit for remainder of project life: = 17,415 HU = (45 years) * (387) * [1.0]
Cumulative HU: 18,382.5 (967.5 HU + 17,415 HU)
AAHU: 367.7 (18,382.5 cumulative HU/50 years)

Fish Access Coefficient: 268.4 AAHU (367.7 AAHU * 0.73)
Mitigation Benefit = 268.4 AAHU (268.4 with mitigation AAHU – 0.0 without mitigation AAHU)

<u>New Madrid Floodway</u>

Borrow Pit Transition: 150 HU = (5 year) * (60) * [(0.0+ 1)/2]
Borrow Pit for remainder of project life: = 2,700 HU = (45 years) * (60) * [1.0]
Cumulative HU: 3,000 (150 HU + 2,700 HU)
AAHU: 57 (3,000 cumulative HU/50 years)
Fish Access Coefficient: 41.6 AAHU (57 AAHU * 0.73)
Mitigation Benefit = 41.6 AAHU (41.6 with mitigation AAHU – 0.0 without mitigation AAHU).

The overall design and specific location would be coordinated with the development of a site-specific detailed mitigation plan.

Ten Mile Pond CA Moist Soil Management

Due to fish access constraints in the existing Ten Mile Pond CA, no fish spawning and rearing habitat is provided.

Seasonally Inundated Farmland

It is anticipated that seasonally inundated farmland would be located above the post-project 5-year flood frequency elevation. Therefore, no fish spawning and rearing compensatory mitigation benefit would be provided. However, seasonally inundated areas within the post-project 5-year floodplain would accrue the applicable compensatory mitigation benefits coordinated through a site-specific detailed mitigation plan.

Floodplain Lakes

As previously stated, there are several floodplain lakes located within the Lower Mississippi River Valley within the State of Missouri that have been degraded by anthropogenic impacts (Appendix A, Figure 4.7). Similar to ecologically designed borrow pits, compensatory mitigation benefits provided from restoring floodplain lakes compensates for project impacts, including impacts to waterbodies and inundated floodplain habitat. The Mississippi River floodplain can be inundated for prolonged periods between winter and early summer. Fish respond to floods by moving laterally onto the floodplain to feed, avoid predators, and seek suitable areas for reproduction. A pulsed hydrograph during the winter and spring provides opportunities for fish to access floodplain habitats and reside for extended periods to feed and reproduce. Floodplain lakes can harbor both resident and transient fish, but must be within the 5-year floodplain to be of benefit to Mississippi River (*i.e.*, transient) fish.

Floodplain lakes, such as Riley Lake, exist in the batture area adjacent to the project area (Appendix A, Figure 4.7). Normally these lakes become very shallow or completely dry after floods recede. Larval fish abundance can be high in floodplain lakes for feeding and reproductive purposes. Efforts to maintain suitable water depths after flood waters recede would improve the survival rate and contribute to overall recruitment of fish once a lake was reconnected to the Mississippi River during subsequent flood pulses. Riley Lake is just one example of numerous opportunities to reconnect or manage water levels of floodplain lakes to enhance the survival of early life history stages of fish. For example, the Lower Mississippi River Resource Committee has published a list of backwaters in the Mississippi River floodplain that state and Federal resource agencies have identified as restoration sites. The interagency mitigation team could consider restoring some of these other lakes as mitigation in addition to or in lieu of Riley Lake.

To create viable agricultural land similarly to the vast majority of land within the project area, a ditch was dug in an attempt to drain Riley Lake for agricultural purposes (Robert Henry, personal communication). A rock weir could be constructed within the outlet to restore historic surface elevations and negate the effects of the ditch. Land use around the 36-acre lake is currently agriculture (216 acres) and a cottonwood plantation (180 acres). Table 22 provides the existing AAHU of Riley Lake and the proposed restoration footprint (*i.e.,* elevation of 287 feet).

Table 22. Riley Lake, existing AAHU.

Land Use	Acres	ADFA[1]	HSI	AAHU
Tree Farm	180	55.8	1.0	55.8
Agriculture	216	67	0.2	13.4
Water	36	36	1.0	36
TOTAL	**432**	**158.8**		**105.2**

[1]Based on H+H analysis, ADFA is approximately 31% per acre.

A weir could be constructed to restore Riley Lake to an elevation of 287 feet. Therefore, the lake would be restored to 432 acres, providing 432 AAHU (432 ADFA * 1.0 HSI) by restoring surface elevations to an elevation of 287 feet. Thus, the restoration of Riley Lake would provide a benefit of 326.8 AAHU (432 AAHU – 105.2 AAHU) for each of the three spawning and rearing periods.

Conclusion

Tables 23 and 24 provide the overall mitigation results. Additional details regarding mitigation are found in Sections 5 and 7.

Table 23. Fisheries compensatory mitigation benefits (AAHU) in the St. Johns Bayou Basin.

Mitigation	Acres	Early	Mid	Late
Impacts		-386.6	-441.3	-245.3
BLH Restoration < 285'	400	40.7	41.9	15.4
BLH Restoration < 5-year	1,816	124.2	127.9	50.1
Riparian Buffer Strips	47	5.9	5.6	1.8
Ecologically Designed Borrow Pits	387	268.4	268.4	268.4
Net Gain		52.6	2.5	90.4

Table 24. Fisheries compensatory mitigation benefits (AAHU) in the New Madrid Floodway.

Mitigation	Acres	Early	Mid	Late
Impacts		-1,729.5	-2,061.1	-1,165.8
Big Oak Tree State Park and Surrounding Area	2,800	914.0	889.5	577.3
BLH Restoration < 285'	387	61.7	70.5	0.0
BLH Restoration < 5-year	1,970	179.3	84.7	0.0
Batture Land Reforestation	3,050	692.4	692.4	310.2
Ecologically Designed Borrow Pits	60	41.6	41.6	41.6
Floodplain Lake	432	326.8	326.8	326.8
Net Gain		486.2	44.4	90.1

Additional opportunities could be explored during the development of site-specific mitigation plans. Any changes would be coordinated in a site specific mitigation plan and applicable NEPA documentation would be prepared.

Ditches

Consistent with the determination of impacts, the Missouri Stream Mitigation Method (MSMM) was used to determine credits generated from mitigation techniques. Compensatory stream mitigation generally means the manipulation of the physical, chemical, and/or biological characteristics of a stream with the goal of repairing or replacing its natural functions. The purpose is to compensate for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization measures have been achieved and should be designed to restore, enhance, and maintain stream uses that are adversely impacted by authorized activities.

River rehabilitation projects are now widespread throughout the United States and Europe, which employ techniques to restore natural river features that have been lost through channelization by narrowing and re-meandering channelized reaches, re-profiling banks that are very steep, and creating specific features such as riffles and backwaters (Pretty et al. 2003).

To compensate for impacts associated with the proposed channel work, a suite of mitigation techniques are proposed that are practicable, applicable, and suitable to replace (or enhance) ecosystem functions currently offered by project area ditches. Mitigation techniques include:

- Constructing nine transverse dikes in the lower 3.7 miles of St. Johns Bayou to create a low flow sinuous channel.
- Constructing a bank stability structure (*i.e.,* weir) at the confluence of St. Johns Bayou and Setback Levee Ditch to provide stability as well as provide structure.
- Constructing a bank stability structure at the confluence of Setback Levee Ditch and St. James Ditch.
- Creating stream bank slopes that are designed to prevent erosion and maximize fish and wildlife habitat.
  - Langler and Smith (2001) found that habitat restoration using graded banks significantly increased the abundance and diversity of fish populations through increased structural complexity (vegetation for spawning substratum) and offered areas of increased temperature (which can increase growth rate through enhanced food assimilation rate, and possibly, indirect effects by increased supply of food).
- Establishing buffer strips consisting of both woody vegetation on one bank and warm season grasses on the opposite bank along reaches of ditches that were previously farmed to top bank as well as replanting vegetation in areas cleared by construction efforts. All efforts would be made to establish the woody vegetation on the ditch bank that would provide the maximum amount of shade to the ditch.
  - Although USACE would ensure buffer strips are established on both banks, credit would only be taken for woody vegetation, therefore, grass buffers would be planted and maintained as an environmental design feature.
- Placing spoil material from all future maintenance activities outside of the mitigation rights-of-way.

Following acquisition of site-specific mitigation tracks, a Standard Operating Procedure (SOP) manual will be created detailing mitigation areas that are to be preserved/maintained by the project sponsor despite future maintenance requirements.

In-Stream Work

In many rivers, natural patterns of sediment transport, erosion, and deposition re-create morphological features such as riffles and pools following channel modification (Pretty et al. 2003). Due to the agricultural setting of the project area ditches and their required maintenance (vegetation and sediment removal), natural restoration would not occur. Instead, artificial structures at known locations that can be avoided by routine maintenance are proposed to gain mitigation credit through the MSMM.

St. Johns Bayou Basin

Following USACE and MSMM guidelines, data sheets were completed to determine mitigation credits resulting from in-stream work, restoration or enhancement and relocation worksheet (Appendix P, Part 3). The following assumptions were used:

- St. Johns Bayou (Net Benefit 1 and 2), Setback Levee Ditch (Net Benefit 3), and St. James Ditch (Net Benefit 4) were classified as perennial stream type. The perennial stream type designation was applied due to the fact that these ditches have flowing water year-round during a typical year.
- St. Johns Bayou, Setback Levee Ditch, and St. James Ditch were classified as tertiary for priority area. The tertiary designation was assigned due to these ditches not meeting criteria to establish them as primary or secondary.
- St. Johns Bayou, Setback Levee Ditch, and St. James Ditch were considered functionally impaired as at least one of the following required criteria has been met:
    - The ditch was previously channelized.
    - The ditch has little or no riparian buffer on one or both sides.
    - The ditch has extensive human-induced sedimentation.
- In stream work in St. Johns Bayou was assigned a net benefit of 2, classified as a “good” stream channel restoration/enhancement. The nine transverse dikes proposed meet the designated criteria for restoring in-stream channel features using methodology appropriate to stream type. Additionally, steep upper slopes will be re-shaped and both the stream bed (via nine transverse dikes) and banks (via sloping) will be stabilized.
- In stream work in Setback Levee Ditch (Net Benefit 3) and St. James Bayou (Net Benefit 4) were assigned a net benefit of 1, classified as a “moderate” stream channel restoration/enhancement. Actions proposed in both ditches (the placement of riprap and confluence areas as well as creating stream bank slopes that are designed to prevent erosion and maximize fish and wildlife habitat) meet the designated criteria of restoring streambank stability in moderately eroded areas, as well as stabilizing the stream channel in place. All ditches were assigned a Level II monitoring program, as both plant survival and channel stability will be monitored in accordance with the MSMM.
- All ditches were assigned a Schedule 2 mitigation construction timing, as a majority of the mitigation would be completed concurrent with impacts.

Mitigation credits resulting from in-stream work would generate 384,099.9 stream credits.

<u>New Madrid Floodway</u>

No in-steam work is proposed within the New Madrid Floodway.

Riparian Buffer Creation

Riparian areas are critical components of stream ecosystems that provide important ecological functions, and directly influence the functions of streams, especially in terms of habitat quality and water quality. As greater than 80 percent of the project area is devoted to agricultural production (which consists of applying copious amounts of fertilizer and pesticides to maximize yields), riparian buffer establishment along ditches adjacent to agricultural fields may very well provide the greatest ecosystem service to an area so highly manipulated for anthropogenic purposes.

Because of the agricultural nature of the project area ditches, many reaches have no riparian vegetation present, serving as a means to access the ditch for inspection and maintenance purposes as well as maximizing all land available to the farmer. Due to this fact, establishment of woody vegetation along both banks is not practical. Consultation with members on the Mitigation Banking Review Team (IRT) and an Independent External Peer Review (IEPR) panel has suggested that woody vegetation be established on one bank and warm season grasses on the opposite bank, which would serve as the construction/maintenance side. Although grass buffers do not provide shade to the level of woody vegetation, in agricultural regions, grassy areas may be more effective in reducing bank erosion and trapping suspended sediments than wooded areas (Lyons 2000). In fact, Castle et al. (1994) reported that grass buffer strips as narrow as 15 feet trapped approximately 90 percent of NH_4-N, NO_3-N and PO_4-P, and that trapping efficiencies increased to between 96 percent and 99.9 percent when the buffer width was increased to 30 feet. Wolf (2009) also noted that switchgrass provides excellent erosion control when used as filter strips, grass hedges, or cover such as river levee banks. In addition, Moore et al. (2000) stated that agricultural ditches in the Mississippi Alluvial Delta have been recognized as comparable substitutes for edge-of-field wetlands and can provide areas for mitigation of non-point source pollution.

However, as previously stated, due to interagency team (IAT) concerns of the grass buffer being used as access to periodically to maintain agricultural ditches in the project area, the grass buffer will be implemented as an environmental design feature and no mitigation credit will be taken through the MSMM.

St. Johns Bayou Basin

Following USACE and MSMM guidelines, data sheets were completed to determine mitigation credits in the St. Johns Bayou Basin resulting from riparian buffer creation, enhancement, restoration, and preservation worksheet (Appendix P, Part 3). The following assumptions were used:

- St. Johns Bayou (Net Benefit 1 and 2), Setback Levee Ditch (Net Benefit 3), and St. James Ditch (Net Benefit 4) were classified as perennial stream type. The perennial stream type designation was applied due to the fact that these ditches have flowing water year-round during a typical year. St. Johns Bayou, Setback Levee Ditch, and St. James Ditch were classified as tertiary for priority area. The tertiary designation was assigned due to these ditches not meeting criteria to establish them as primary or secondary. St. Johns Bayou, Setback Levee Ditch, and St. James Ditch would be provided a woody riparian buffer of 25 feet on one bank. Therefore a net benefit of 0.4 was applied.
    - Note: The grass vegetative buffer would be planted on the opposite bank at 40 feet wide as an environmental design feature, and no mitigation credit would be taken.
- St. Johns Bayou, Setback Levee Ditch, and St. James Ditch were assigned a Level II monitoring program, as both plant survival and channel stability will be monitored in accordance with the MSMM. St. Johns Bayou, Setback Levee Ditch, and St. James Ditch were assigned a site protection credit of 0.2, which is defined as USACE approved site protection recorded with third party guarantee, or transfer of title to a conservancy.
- St. Johns Bayou, Setback Levee Ditch, and St. James Ditch were assigned a Schedule 2 mitigation construction as a majority of the mitigation would be completed concurrent with impacts.
- Riparian buffers along St. Johns Bayou were assigned a temporal lag of 10 to 20 years (-0.2).
    - Woody vegetation is currently present along select reaches of St. Johns Bayou.
- Riparian buffers along Setback Levee Ditch and St. James Ditch were assigned a temporal lag of 0 to 5 years.
    - These stretches of ditch currently have little to no areas of riparian vegetation present.

Mitigation credits resulting from riparian buffer creation along ditches in the St. Johns Bayou Basin would generate 173,330.3 stream credits.

After an impact resulting in the need to mitigate for 699,685.6 stream credits, the in-stream work generated 384,099.9 stream credits and the riparian buffer creation generated 173,330.3 credits; a total of 142,255.4 stream credits remain unaccounted for.

As noted in the Compensatory Mitigation Plan Requirements for Permittee Responsible Mitigation Projects, mitigation sites containing streams and other open waters should include riparian areas as part of the overall compensatory mitigation project. In such cases, compensatory mitigation credits should also be awarded to riparian areas in accordance with the State of Missouri Stream Mitigation Method. As noted in previous sections of the draft EIS, borrow pits would be created as part of the authorized project and riparian buffers could be established along the banks to compensate for any remaining stream mitigation credits.

To calculate the mitigation credits that would be provided by 387 acres of borrow pits (Net Benefit 5) in the St. Johns Bayou Basin the following assumptions were made to ensure a conservative estimate:

- The 387 acres of borrow pits were assumed to be from one collective area. Therefore, when actual borrow pits are created, the riparian buffer would not be any shorter, in terms of linear feet, than one which would have come from a single borrow site.
- The riparian buffer was assumed to be straight with no sinuosity. Although, ecologically designed borrow pits would be constructed (consisting of sinuous shoreline to achieve maximum ecological benefits), using a homogenous shoreline ensures a conservative estimate.
- A perennial stream type was assigned as borrow pits would contain water year-round.
- A priority area of tertiary was assigned as a conservative estimate.
- A net benefit was calculated for 25 feet of woody riparian buffer on only one side, although the riparian buffer would encompass the borrow pit.
- A Level II monitoring contingency was assigned. Plant survival and Photo Reference/Sample Site would be included in the mitigation component. Please note that to make a conservative estimate, it was assumed that only one side would be monitored, although the riparian buffer would encompass the borrow pit.
- A value of 0.2 was assigned for site protection, as this would be a USACE approved site protection recorded with third party grantee, or transfer of title to a conservancy.
- A Schedule 2 mitigation construction timing would be utilized, as a majority of mitigation would be completed concurrent with impacts.
- A temporal lag of 10 – 20 years was assigned as woody vegetation would be expected to become established during this time frame.

A 25-foot buffer around a 387-acre borrow pit would result in 14,658.7 linear feet of buffer. When applied to the MSMM using the previously described assumptions, 18,323.4 riparian restoration credits would be generated. Applying those credits to the remaining mitigation debit, 123,932 debits remain unaccounted for.

To mitigate for the remaining debits, a 25 foot riparian buffer consisting of woody vegetation on one bank and warm season grasses on the opposite bank could be established on an area ditch for 18.8 miles (Net Benefit 6).

To determine the mitigation credits that would be provided by a 18.8-mile, 25-foot wide riparian buffer along a hypothetical ditch in the St. Johns Bayou Basin the following assumptions were made to ensure a conservative estimate:

- The proposed mitigation reach (Net Benefit 6) was assumed to be intermittent, having flowing water only during certain times of the year.
- The proposed mitigation reach was classified as tertiary for priority area.

- The proposed mitigation reach would be provided a woody riparian buffer of 25 feet on one bank. Therefore a net benefit of 0.4 was applied.
    - Note: The grassy vegetative buffer would be planted on the opposite bank at 25-feet wide as an environmental design feature, although no mitigation credit would be given.
- The proposed mitigation reach was assigned a Level II monitoring program, as both plant survival and channel stability will be monitored in accordance with the MSMM.
- The proposed mitigation reach was assigned a site protection credit of 0.2, which is defined as USACE approved site protection recorded with third party grantee, or transfer of title to a conservancy.
- The proposed mitigation reach was assigned a Schedule 2 mitigation construction as a majority of the mitigation would be completed concurrent with impacts.
- Riparian buffers along the proposed mitigation reach were assigned a temporal lag of 0 to 5 years.
    - Target stretches of ditch would currently have little to no areas of riparian vegetation present.

A 25-foot buffer (woody vegetation on one bank) along 18.8 miles of an intermittent ditch would result in 99,250 linear feet of buffer. When applied to the MSMM using the previously described assumptions, 124,062.5 riparian restoration credits would be generated. Applying those credits to the remaining mitigation debit results in full mitigation for impacts to ditches in the St. Johns Bayou Basin, according to the MSMM.

New Madrid Floodway

Following USACE and MSMM guidelines, data sheets were completed to determine mitigation credits in the New Madrid Floodway resulting from riparian buffer creation, enhancement, restoration, and preservation worksheet (Appendix P, Part 3).

As in the St. Johns Bayou Basin, to mitigate for the 1,087.2 stream debits in the New Madrid Floodway, a 25-foot riparian buffer consisting of woody vegetation could be established around the 60 acres of proposed borrow pits.

To calculate the mitigation credits that would be provided by 60 acres of borrow pits (Net Benefit 1) in the New Madrid Floodway the following assumptions were made to ensure a conservative estimate:

- The 60 acres of borrow pits were assumed to be from one collective area. Therefore, when actual borrow pits are created, the riparian buffer would not be any shorter, in terms of linear feet, than one which would have come from a single borrow site.
- The riparian buffer was assumed to be straight with no sinuosity. Although, ecologically designed borrow pits would be constructed (consisting of sinuous shoreline to achieve maximum ecological benefits), using a homogenous shoreline ensures a conservative estimate.

- A perennial stream type was assigned as borrow pits would contain water year-round.
- A priority area of tertiary was assigned as a conservative estimate.
- A net benefit was calculated for 25 feet of woody riparian buffer on only one side, although the riparian buffer would encompass the borrow pit.
- A Level II monitoring contingency was assigned. Plant survival and Photo Reference/Sample Site would be included in the mitigation component. Please note that to make a conservative estimate, it was assumed that only one side would be monitored, although the riparian buffer would encompass the borrow pit.
- A value of 0.2 was assigned for site protection, as this would be a USACE approved site protection recorded with third party grantee, or transfer of title to a conservancy.
- A Schedule 2 mitigation construction timing would be utilized, as a majority of mitigation would be completed concurrent with impacts.
- A temporal lag of 10 – 20 years was assigned as woody vegetation would be expected to become established during this time frame.

A 25-foot buffer around a 60 acre borrow pit would result in 5,799.1 linear feet of buffer. When applied to the MSMM using the previously described assumptions, 7,248.9 riparian restoration credits would be generated. Applying those credits to the mitigation debit, a surplus of 6,185.2 mitigation credits are generated.